machine translation of Ref. (2)

* NOTICES *

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2.**** shows the word which can not be translated.
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CLAIMS

[Claim(s)]
[Claim 1]In a wireless network constituted by a wireless node which transmits and receives a packet via a wireless interface, and specific wireless node which becomes a gateway with an external network, An adjacent node transmitted in order that said specific wireless node may send a packet to a destination node (henceforth a "address") and a destination node (henceforth "contiguity"), By the time a packet reaches a destination node, metric (henceforth a "hop number") of a required course, A course control table where each wireless node described a value (henceforth "a course check") showing whether a packet was received or not into predetermined time is held, an "address" which makes "contiguity" the same -- a route maintaining packet which indicated all, [generate and] The unicast of this route maintaining packet is carried out to a wireless node applicable to "contiguity", Check receiving a course maintenance reply packet which a wireless node which received said route maintaining packet transmitted, and maintaining each course, and said wireless node, When a course control table in which an "address", "contiguity", and a "hop number" were described is held and said route maintaining packet is received, all the "addresses" described by this route maintaining packet is taken out, A route maintaining packet which indicated all the the "addresses" which makes the same "contiguity" of said course control table to the "address" is generated, Unicast relay of this route maintaining packet is carried out to a wireless node applicable above "contiguity", When said route maintaining packet does not need to be relayed, or when specified time elapse of said route maintaining packet is relayed and carried out, Generate a course maintenance reply packet to said specific wireless node, and unicast transmission is carried out, When said course maintenance reply packet is received, add information which shows that a route maintaining packet was received by a self-node to the course maintenance reply packet, and unicast relay is carried out, A course maintenance method in a wireless network always checking that a packet reaches between said wireless node and said specific wireless node.
[Claim 2]In a wireless network constituted by a wireless node which transmits and receives a packet via a wireless interface, and specific wireless node which becomes a gateway with an external network, An adjacent node transmitted in order that said specific wireless node may send a packet to a destination node (henceforth a "address") and a destination node (henceforth "contiguity"), By the time a packet reaches a destination node, metric (henceforth a "hop number") of a required course, A course control table where each wireless node described a value (henceforth "a course check") showing whether a packet was received or not into predetermined time is held, Generate a route maintaining packet and this route maintaining packet is broadcast to an adjoining wireless node which is in a range in which direct communication is possible in a radio link, Check receiving a course maintenance reply packet transmitted from a wireless node which received said route maintaining packet, and maintaining each course, and said wireless node, When a course control table in which an "address", "contiguity", and a "hop number" were described is held and said route maintaining packet is received, in being the first route maintaining packet from said specific wireless node, by checking the dispatch origin, A course maintenance method in a wireless network always checking that generate a course maintenance reply packet to said specific wireless node, carry out unicast transmission, and a packet reaches between said wireless node and said specific wireless node.
[Claim 3]In a wireless network constituted by a wireless node which transmits and receives a packet

via a wireless interface, and specific wireless node which becomes a gateway with an external network, An adjacent node transmitted in order that said wireless node may send a packet to a destination node (henceforth a "address") and a destination node (henceforth "contiguity"), By the time a packet reaches a destination node, metric (henceforth a "hop number") of a required course, A course control table where each wireless node described a value (henceforth "a course check") showing whether a packet was received or not into predetermined time is held, Generate a route maintaining packet at predetermined time, and a unicast is carried out to said specific wireless node, Add information which can identify a self-node uniquely when said route maintaining packet is received to a route maintaining packet, and it hooks up to said specific wireless node, If a course maintenance reply packet which said specific wireless node transmitted is received, a course with said specific wireless node will be recorded on said course control table, Discard it, when this course maintenance reply packet is addressing to a self-node, and in addressing to a wireless node of others, relay it, and said specific wireless node holds a course control table in which an "address", "contiguity", and a "hop number" were described, When said route maintaining packet is received, information on a wireless node which passed from this route maintaining packet is taken out, Record the channel information on said course control table, take out a transmitting agency from said route maintaining packet, and the unicast of the course maintenance reply packet is carried out to the transmitting origin, A course maintenance method in a wireless network always checking that a packet reaches between said wireless node and said specific wireless node.

[Claim 4]In a wireless network constituted by a wireless node which transmits and receives a packet via a wireless interface, and specific wireless node which becomes a gateway with an external network, An adjacent node transmitted in order that said wireless node may send a packet to a destination node (henceforth a "address") and a destination node (henceforth "contiguity"), By the time a packet reaches a destination node, metric (henceforth a "hop number") of a required course, A course control table where each wireless node described a value (henceforth "a course check") showing whether a packet was received or not into predetermined time is held, It broadcasts to a wireless node which generates a route maintaining packet and adjoins predetermined time, When the unicast of the course maintenance reply packet is carried out to the transmitting origin when said route maintaining packet is received, and a course maintenance reply packet cannot be received from an adjoining wireless node, A course maintenance method in a wireless network deleting information corresponding to the adjoining wireless node from said course control table, and reconstructing a course.

[Claim 5]In a course maintenance method in the wireless network according to claim 1 or 2, said specific wireless node, A course maintenance method in a wireless network characterized by reconstructing a course between said wireless nodes about predetermined time which reception of a packet used for a "course check" described in said course control table takes when a packet is not sent in the predetermined time from said wireless node.

[Claim 6]In a course maintenance method in the wireless network according to claim 3 or 4, said wireless node, After transmitting a packet to other wireless nodes in a course based on said course control table, even if it carries out specified time elapse, when there is no reply packet, The same course as "contiguity" of a course which does not have a reply packet among "contiguity" described in said course control table is deleted, A course maintenance method in a wireless network broadcasting a fault notification packet to an adjoining wireless node which is in a range in which direct communication is possible in a radio link, and reconstructing a course between said wireless nodes.

[Claim 7]A wireless node which transmits and receives a packet via a wireless interface and which is provided with the following and characterized by always checking that a packet reaches between said wireless node and said specific wireless node, A wireless network constituted by specific wireless node which becomes a gateway with an external network.

An adjacent node transmitted in order that said specific wireless node may send a packet to a destination node (henceforth a "address") and a destination node (henceforth "contiguity"), By the time a packet reaches a destination node, metric (henceforth a "hop number") of a required course, an "address" to which each wireless node holds a course control table which described a value (henceforth "a course check") showing whether a packet was received or not into predetermined time, and makes "contiguity" the same -- a means to generate a route maintaining packet which indicated all.

A means which carries out the unicast of this route maintaining packet to a wireless node applicable to "contiguity."
Have a means to check receiving a course maintenance reply packet which a wireless node which received said route maintaining packet transmitted, and maintaining each course, and said wireless node, When a course control table in which an "address", "contiguity", and a "hop number" were described is held and said route maintaining packet is received, A means to generate a route maintaining packet which indicated all the the "addresses" which takes out all the "addresses" described by this route maintaining packet, and makes the same "contiguity" of said course control table to that "address."
A means which carries out unicast relay of this route maintaining packet to a wireless node applicable above "contiguity", A means which generates a course maintenance reply packet to said specific wireless node, and carries out unicast transmission when said route maintaining packet does not need to be relayed, or when specified time elapse of said route maintaining packet is relayed and carried out, A means which adds information which shows that a route maintaining packet was received by a self-node to the course maintenance reply packet, and carries out unicast relay when said course maintenance reply packet is received.

[Claim 8]When it has the following, said wireless node holds a course control table in which an "address", "contiguity", and a "hop number" were described and said route maintaining packet is received, By checking the dispatch origin, in being the first route maintaining packet from said specific wireless node, It has a means which generates a course maintenance reply packet to said specific wireless node, and carries out unicast transmission, A wireless network constituted between said wireless node and said specific wireless node by a wireless node which transmits and receives a packet via a wireless interface, and always checking that a packet reaches, and specific wireless node which becomes a gateway with an external network.
An adjacent node transmitted in order that said specific wireless node may send a packet to a destination node (henceforth a "address") and a destination node (henceforth "contiguity"), A means to hold a course control table in which a value (henceforth "a course check") showing whether metric (henceforth a "hop number") one of a required course and each wireless node received a packet in predetermined time by the time a packet reached a destination node was described, and to generate a route maintaining packet.
A means to broadcast this route maintaining packet to an adjoining wireless node which is in a range in which direct communication is possible in a radio link.
A means to check receiving a course maintenance reply packet transmitted from a wireless node which received said route maintaining packet, and maintaining each course.

[Claim 9]When it has the following, said specific wireless node holds a course control table in which an "address", "contiguity", and a "hop number" were described and said route maintaining packet is received, A means to take out information on a wireless node which passed from this route maintaining packet, and to record that channel information on said course control table, It has a means which takes out a transmitting agency from said route maintaining packet, and carries out the unicast of the course maintenance reply packet to the transmitting origin, A wireless network constituted between said wireless node and said specific wireless node by a wireless node which transmits and receives a packet via a wireless interface, and always checking that a packet reaches, and specific wireless node which becomes a gateway with an external network.
An adjacent node transmitted in order that said wireless node may send a packet to a destination node (henceforth a "address") and a destination node (henceforth "contiguity"), By the time a packet reaches a destination node, metric (henceforth a "hop number") of a required course, A means which each wireless node holds a course control table which described a value (henceforth "a course check") showing whether a packet was received or not into predetermined time, generates a route maintaining packet at predetermined time, and carries out a unicast to said specific wireless node.
A means to add information which can identify a self-node uniquely when said route maintaining packet is received to a route maintaining packet, and to hook up to said specific wireless node.
A means to record a course with said specific wireless node on said course control table if a course

maintenance reply packet which said specific wireless node transmitted is received.
A means to discard it when this course maintenance reply packet is addressing to a self-node, and to relay it in addressing to a wireless node of others.

[Claim 10]A wireless network constituted by a wireless node characterized by comprising the following which transmits and receives a packet via a wireless interface, and specific wireless node which becomes a gateway with an external network.
An adjacent node transmitted in order that said wireless node may send a packet to a destination node (henceforth a "address") and a destination node (henceforth "contiguity"), By the time a packet reaches a destination node, metric (henceforth a "hop number") of a required course, A means to broadcast to a wireless node which holds a course control table where each wireless node described a value (henceforth "a course check") showing whether a packet was received or not into predetermined time, generates a route maintaining packet and adjoins predetermined time.
A means which carries out the unicast of the course maintenance reply packet to the transmitting origin when said route maintaining packet is received.
A means which deletes information corresponding to the adjoining wireless node from said course control table, and reconstructs a course when a course maintenance reply packet cannot be received from an adjoining wireless node.

[Claim 11]In a course maintaining system in the wireless network according to claim 7 or 8, said specific wireless node, About predetermined time which reception of a packet used for a "course check" described in said course control table takes, when a packet is not sent in the predetermined time from said wireless node, A course maintaining system in a wireless network provided with a means to reconstruct a course between said wireless nodes.
[Claim 12]A course maintaining system characterized by comprising the following in the wireless network according to claim 10 or 9.
A means to delete the course as "contiguity" of a course which does not have a reply packet among "contiguity" described in said course control table in which it is the same when there is no reply packet, even if it carries out specified time elapse of it, after said wireless node transmits a packet to other wireless nodes in a course based on said course control table.
A means to broadcast a fault notification packet to an adjoining wireless node which is in a range in which direct communication is possible in a radio link.
A means to reconstruct a course between said wireless nodes.

[Claim 13]A wireless node device comprising:
A wireless node which transmits and receives a packet via a wireless interface.
Each means of a specific wireless node which constitutes a course maintaining system in the wireless network according to any one of claims 7 to 11 in a wireless network constituted by specific wireless node which becomes a gateway with an external network.

[Claim 14]A wireless node device comprising:
A wireless node which transmits and receives a packet via a wireless interface.
Each means of a wireless node which constitutes a course maintaining system in a wireless network given in either of claims 7-10, and 12 in a wireless network constituted by specific wireless node which becomes a gateway with an external network.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]Each wireless node accesses a specific wireless node frequently, and this invention relates to the course maintenance method, course maintaining system, and wireless node device which perform course maintenance with a specific wireless node in a wireless network with little access between other wireless nodes.
[0002]
[Description of the Prior Art]The conventional course management about the packet transfer between the wireless nodes (henceforth a "node") in a wireless network, There are a table drive system which always builds the course, a method on demand which builds a transfer path when the necessity for communication arises, and a hybrid system which combined the table drive system and the method on demand.
[0003]Since channel information is notified to each node, each node reconstructs a course based on the information and a table drive system maintains a course when each node is periodical or detects change of topology, when communication arises, it can start transmission of a packet immediately. However, in the communication configuration accessed frequently [a specific node] from many nodes, the processing and communication for unnecessary course construction arise.
[0004]On the other hand, a method on demand, For example, literature. (Charles E. Perkins, "Ad Hoc On-Demand Distance Vector Routing", in Proceedings of the 2nd IEEE Workshopon Mobile Computing) In Systems and Applications, pp.90-100, and AODV (Ad Hoc On-Demand Distance Vector Routing) proposed by 1999. When communication arises, a path planning packet is broadcast to the whole network, and course construction is attained when a destination node etc. return the reply. Therefore, although it becomes unnecessary [the processing for course maintenance] to a specific course, delay after communication arises until the first data packet is transmitted is not avoided. Since communication is impossible if the adjacent node which is in the range in which direct communication is possible in a radio link cannot be recognized, a route maintaining packet is broadcast to the adjacent node in the range in which direct communication is possible. Although the node which received this route maintaining packet recognizes an adjacent node (transmission node) by receiving a route maintaining packet, if this route maintaining packet is not received fixed time, it recognizes that change of the topology by an obstacle etc. broke out. For this reason, by the time it recognizes that change of topology broke out, the time beyond this fixed time will be needed.
[0005]A hybrid system, For example, literature. Zygmunt J. Hass,"A New Routing Protocol for the Reconfigurable Wireless Networks", in IEEE ICUPC'97,pp.652-566. In ZRP (Zone Routing Protocol) proposed by 1997. The concept of a zone radius is introduced, and each node manages the course to the node in a zone radius with a table drive system, and suppose that the course to the node besides a zone radius is built by a method on demand. For this reason, if a zone radius is set up a specific node come in a zone radius, in the communication configuration accessed frequently [a specific node] from many nodes, the processing and communication for unnecessary course construction will arise like a table drive system. When a zone radius is set up a specific node come out of a zone radius on the other hand, in the communication configuration in which a specific node is frequently accessed from many nodes, delay will always arise like a method on demand.

[0006]
[Problem(s) to be Solved by the Invention]By the way, since the specific node used as a gateway with an external network will be frequently accessed from many nodes, the above problems arise in such a communication configuration.
[0007]That is, in the conventional table drive system, if it is necessary to have the channel information over all the nodes and an obstacle etc. detect change of topology, it is necessary to notify the detected node to all the nodes for reconstruction of a course, and each node needs to reconstruct a course based on this notice. Thus, the non-line zone region where the access frequency to "a specific node" follows maintaining the course of all the nodes on the course construction processing of those other than "a specific node", the processings for course maintenance, and these processings in a high system becomes useless.
[0008]In the communication configuration in which a specific node is frequently accessed from many nodes instead of [which does not need to perform course maintenance], delay will always produce the conventional method on demand. Especially each node only transmits a route maintaining packet only to an adjacent node, did not receive the reply of the route maintaining packet from an adjacent node, and was not able to check whether the adjacent node would have received the route maintaining packet. Therefore, since it could not be coped with but change of topology needed to be recognized by another means when it cannot transmit to an adjacent node, although it could receive from the adjacent node, by the time it has recognized change of topology and reconstructed the course, time was taken, and delay was large.
[0009]Since the conventional hybrid system changes a table drive system and a method on demand with the distance from a node, it has each problem of the conventional table drive system and a method on demand as it is.
[0010]In the wireless network with little access between other nodes in which this invention accesses a node with each specific node frequently, To course maintenance with a specific node, it is delayed small, and aims at providing the course maintenance method, course maintaining system, and wireless node device which can exclude the futility of the non-line zone region in accordance with useless course construction processing, the processings for course maintenance, and these processings.
[0011]
[Means for Solving the Problem]A course maintenance method in a wireless network, a course maintaining system, and a wireless node device of this invention, In a specific wireless node, as opposed to each wireless node, each wireless node transmits a route maintaining packet to a specific wireless node, A node which received a route maintaining packet transmits a course maintenance reply packet, and a transmission node of a route maintaining packet maintains a course between a specific wireless node and each wireless node by the confirmation of receipt of a course maintenance reply packet.
[0012]By invention of a statement, to claims 1, 7, 13, and 14. A specific wireless node holds a course control table in which an "address", "contiguity", a "hop number", and a "course check" were described, an "address" which makes "contiguity" the same -- a route maintaining packet which indicated all, [generate and] It checks carrying out the unicast of this route maintaining packet to a wireless node applicable to "contiguity", receiving a course maintenance reply packet which a wireless node which received a route maintaining packet transmitted, and maintaining each course.
[0013]When a wireless node holds a course control table in which an "address", "contiguity", and a "hop number" were described and a route maintaining packet is received, Take out all the "addresses" described by this route maintaining packet, and a route maintaining packet which indicated all the the "addresses" which makes "contiguity" of a course control table the same to that "address" is generated, Unicast relay of this route maintaining packet is carried out to a wireless node applicable to "contiguity", When a route maintaining packet does not need to be relayed, or when specified time elapse of the route maintaining packet is relayed and carried out, A course maintenance reply packet to a specific wireless node is generated, unicast transmission is carried out, when a course maintenance reply packet is received, information which shows that a route maintaining packet was received by a self-node is added to the course maintenance reply packet, and unicast relay is carried out.
[0014]By invention of a statement, to claims 2, 8, 13, and 14. A specific wireless node holds a course

control table in which an "address", "contiguity", a "hop number", and a "course check" were described, It checks generating a route maintaining packet, broadcasting this route maintaining packet to an adjoining wireless node which is in a range in which direct communication is possible in a radio link, receiving a course maintenance reply packet transmitted from a wireless node which received a route maintaining packet, and maintaining each course.

[0015]When a wireless node holds a course control table in which an "address", "contiguity", and a "hop number" were described and a route maintaining packet is received, The dispatch origin is checked, and in being the first route maintaining packet from a specific wireless node, a course maintenance reply packet to a specific wireless node is generated, and it carries out unicast transmission.

[0016]By invention of a statement, to claims 3, 9, 13, and 14. A wireless node holds a course control table in which an "address", "contiguity", a "hop number", and a "course check" were described, Generate a route maintaining packet at predetermined time, and a unicast is carried out to a specific wireless node, Add information which can identify a self-node uniquely when a route maintaining packet is received to a route maintaining packet, and it hooks up to a specific wireless node, If a course maintenance reply packet which a specific wireless node transmitted is received, a course with a specific wireless node will be recorded on a course control table, when this course maintenance reply packet is addressing to a self-node, it is discarded, and in addressing to a wireless node of others, it is relayed.

[0017]When a specific wireless node holds a course control table in which an "address", "contiguity", and a "hop number" were described and a route maintaining packet is received, Information on a wireless node which passed from this route maintaining packet is taken out, that channel information is recorded on a course control table, a transmitting agency is taken out from a route maintaining packet, and the unicast of the course maintenance reply packet is carried out to that transmitting origin.

[0018]By invention of a statement, to claims 4, 10, 13, and 14. A wireless node holds a course control table in which an "address", "contiguity", a "hop number", and a "course check" were described, It broadcasts to a wireless node which generates a route maintaining packet and adjoins predetermined time, When the unicast of the course maintenance reply packet is carried out to the transmitting origin when a route maintaining packet is received, and a course maintenance reply packet cannot be received from an adjoining wireless node, information corresponding to the adjoining wireless node is deleted from a course control table, and a course is reconstructed.

[0019]In an invention given in claims 5, 11, and 13, about predetermined time which reception of a packet used for a "course check" described in a course control table takes, a specific wireless node reconstructs a course between wireless nodes, when a packet is not sent in the predetermined time from a wireless node.

[0020]By invention of a statement, to claims 6, 12, and 14, a wireless node, After transmitting a packet to other wireless nodes in a course based on a course control table, even if it carries out specified time elapse, when there is no reply packet, The same course as "contiguity" of a course which does not have a reply packet among "contiguity" described in a course control table is deleted, a fault notification packet is broadcast to an adjoining wireless node which is in a range in which direct communication is possible in a radio link, and a course between wireless nodes is reconstructed.

[0021]

[Embodiment of the Invention]Drawing 1 shows the example of composition of a wireless network. In a figure, the specific node used as a gateway with an external network is set to AP (access point), Node WR1 and WR2 are connected to particular node AP via a radio link, Furthermore node WR1 and node WR4 are connected, node WR4, node WR3, WR5, WR6, and WR7 are connected, node WR2 and node WR5 are connected, the nodes WR5 and WR7 are connected further, and node WR3 and node WR6 are connected.

[0022]The course control table of each node comprises "an address (destination node)", "contiguity (adjacent node transmitted in order to send a packet to a destination node)", and "a hop number (by the time a packet reaches a destination node, it is metric [of a required course])." For example, in particular node AP, it becomes contiguity WR1 and the hop number 1 to address WR1, and becomes contiguity WR1 and the hop number 2 to address WR3. The contiguity at the time of making particular node AP into an address and a hop number are set to the course control table of each node WR 1-7.

[0023]As for this invention, in particular node AP, as opposed to each nodes WR1-WR7, each nodes WR1-WR7 transmit a route maintaining packet to particular node AP, The node which received the route maintaining packet transmits a course maintenance reply packet, and the transmission node of a route maintaining packet maintains the course between particular node AP and each nodes WR1-WR7 by the confirmation of receipt of a course maintenance reply packet. Hereafter, the embodiment led by AP which transmits a route maintaining packet from particular node AP to each nodes WR1-WR7, and the embodiment of WR initiative to which each nodes WR1-WR7 transmit a route maintaining packet to particular node AP are described.
[0024]The embodiment led by <AP: Claims 1, 2, 5, 7, and 8 and 11> drawing 2 show the course control table of particular node AP in led by AP. The composition of a wireless network and the course control table of the nodes WR1-WR7 are the same as what is shown in drawing 1.
[0025]In the course control table of particular node AP, the column of a "course check" other than an "address", "contiguity", and a "hop number" is provided. A "course check" means whether each node received the route maintaining packet in predetermined time by the confirmation of receipt of a course maintenance reply packet.
[0026](The 1st control sequence led by AP: Claims 1 and 7) The 1st control sequence led by AP is explained with reference to drawing 3 - drawing 7. Drawing 3 shows the control sequence at the time of the route maintaining packet transmission in particular node AP. Drawing 4 shows the control sequence in the nodes WR1-WR7. Drawing 5 shows the control sequence at the time of the course maintenance reply packet reception in particular node AP. Drawing 6 shows the example of composition of a route maintaining packet. Drawing 7 shows the example of composition of a course maintenance reply packet.
[0027](Control sequence at the time of the route maintaining packet transmission in particular node AP) In drawing 2 and 3, if it investigates whether particular node AP has an unsettled group which becomes a course control table from an "address", "contiguity", and a "hop number" and there is an unsettled group, a route maintaining packet will be generated. As for a route maintaining packet, as shown in drawing 6, packet kind, address, contiguity, hop number, and transmitting origin and a sending agency comprise a real address. A real address means the node which should receive a route maintaining packet.
[0028]Here, the groups of the "address" of the course control table of particular node AP, "contiguity", and a "hop number" are described to be [an address, contiguity, and a hop number]. First, as shown in drawing 2, there is a group of [WR1, WR1, 1], and it turns out that an adjacent node is WR1 (s1). The route maintaining packet of contiguity WR1 here by that (it is the first route maintaining packet) not existing (s2), Drawing 6 (1) A route maintaining packet (transmitting [course maintenance, address:WR1, contiguity:WR1, hop number:1, and] origin: packet kind : AP and dispatch origin : AP and real address:WR1) as shown is generated (s3). Next, about [WR2, WR2, 1], the route maintaining packet (transmitting [course maintenance address:WR2, contiguity:WR2, hop number:1, and] origin: packet kind : AP and dispatch origin : AP and real address:WR2) of contiguity WR2 is generated in the similar manner (s3).
[0029]Next, since the route maintaining packet of contiguity WR1 already exists about [WR3, WR1, 3] (s2), WR3 is added to the real address of this route maintaining packet (s4, drawing 6 (2)). Since the route maintaining packet of contiguity WR1 already exists if attached to [WR4, WR1, 2] (s2), WR4 is added to the real address of this route maintaining packet (s4, drawing 6 (3)). The route maintaining packet by the addition of a real address is generated also to [WR5, WR2, 2], [WR6, WR1, 3], and [WR7, WR2, 3] like the following, respectively.
[0030]As for a route maintaining packet, two kinds, WR1 direction and WR 2-way, are generated by the above. As for the route maintaining packets of WR1 direction, :AP and dispatch origin is [packet kind:course maintenance, address:WR1, contiguity:WR1, hop number:1, and transmitting origin] :AP and real address:WR1, WR3, WR4, and WR6 (drawing 6 (4)). On the other hand, as for the route maintaining packets of WR 2-way, :AP and dispatch origin is [packet kind:course maintenance, address:WR2 contiguity:WR2, hop number:1, and transmitting origin] :AP and real address:WR2, WR5, and WR7 (drawing 6 (5)). And the course check of each course is carried out during course investigation, and two kinds of route maintaining packets are transmitted to node WR1 and WR2.
[0031](Control sequence in the nodes WR1-WR7) In drawing 2 and 4, node WR1 reception of a route

maintaining packet will investigate whether a real address has nodes other than a self-node (s12). (s11) Here, since a real address has node WR3 other than a self-node, WR4, and WR6, a route maintaining packet is generated according to the course control table of node WR1 (s13-s17). Since it turns out that [WR4, WR4, 1] to contiguity of a course control table is WR4 and the route maintaining packet of contiguity WR4 does not exist to real address WR4, The route maintaining packet (packet kind: course maintenance, address:WR4, contiguity:WR4, hop number:1, real address:WR4) of contiguity WR4 is generated. Since the route maintaining packet of contiguity WR4 already exists if attached to [WR6, WR4, 2], WR6 is added to the real address of this route maintaining packet. It is the same even if attached to [WR3, WR4, 2]. Thereby, node WR1 transmits the route maintaining packet used as packet kind:course maintenance, address:WR4, contiguity:WR4, hop number:1, real address:WR3, WR4, and WR6 to node WR4 (s18), and it becomes the receiving waiting of a course maintenance reply packet (s19).

[0032]Node WR4 will be processed like node WR1, if the route maintaining packet from node WR1 is received. That is, the route maintaining packet used as packet kind:course maintenance, address:WR3, contiguity:WR3, hop number:1, and real address:WR3 is transmitted to node WR3 (s18). The route maintaining packet used as packet kind:course maintenance, address:WR6, contiguity:WR6, hop number:1, and real address:WR6 is transmitted to node WR6 (s18). And it becomes the receiving waiting of a course maintenance reply packet (s19).

[0033]Since any nodes other than a self-node do not exist in a real address if the route maintaining packet from node WR4 is received (s12), node WR3 generates the course maintenance reply packet to particular node AP which is a transmitting agency, and it replies it to node WR4 (s23, s24). As for a course maintenance reply packet, as shown in drawing 7, packet kind, address, contiguity, hop number, and transmitting origin and a sending agency comprise a normal course. This course maintenance reply packet is set as packet kind:course maintenance reply, address:AP, and contiguity:WR4, hop number:3, transmitting agency:WR3, sending agency:WR3, and normal course:WR3 (drawing 7 (1)). Node WR6 performs the same processing as node WR3.

[0034]Node WR4 is the receiving waiting of the course maintenance reply packet in s19, If a course maintenance reply packet is received from the nodes WR3 and WR6 (s20, s21), the course maintenance reply packet which added the self-node to those normal courses and which newly generated the course maintenance reply packet and received will be canceled. A new course maintenance reply packet is set as packet kind:course maintenance reply, address:AP, and contiguity:WR1, hop number:2, transmitting agency:WR4, sending agency:WR4, normal course:WR3, WR4, and WR6 (drawing 7 (2)), and is transmitted to node WR1 (s22).

[0035]Node WR1 performs the same processing as node WR4. A course maintenance reply packet is set to packet kind:course maintenance reply, address:AP, contiguity:AP, and hop number:1, transmitting agency:WR1, sending agency:WR1, normal course:WR1, WR3, WR4, and WR6 (drawing 7 (3)), and is transmitted to particular node AP.

[0036]About the root of node WR2, WR5, and WR7, similarly From node WR2 to a packet kind:course maintenance reply. Address: The course maintenance reply packet set to AP, contiguity:AP, and hop number:1, transmitting agency:WR2, sending agency:WR2, normal course:WR2, WR5, and WR7 is transmitted to particular node AP.

[0037](Control sequence at the time of the course maintenance reply packet reception in particular node AP) In drawing 2 and 5, After particular node AP transmits two kinds of route maintaining packets to node WR1 and WR2, If it is the receiving waiting of the course maintenance reply packet (s31) and the course maintenance reply packet from node WR1 is received in predetermined time (s32), Normal course WR1, WR3, WR4, and WR6 are taken out from a course maintenance reply packet, and each course check corresponding to address WR1 of a course control table, WR3, WR4, and WR6 is changed into O.K. out of course investigation (s33). The course maintenance reply packet from node WR2 is processed similarly (s34).

[0038](Processing at the time of the fault occurrence between WR5 and WR7: Claims 5 and 11) In drawing 2, node WR5 transmits a route maintaining packet to node WR7 according to the procedure which received and mentioned the route maintaining packet above from node WR2, and it goes into the reception waiting state of a course maintenance reply packet (drawing 4, s19). Here, even if it carries out specified time elapse, when a course maintenance reply packet is not received from node WR7, node WR5 generates a course maintenance reply packet. This course maintenance reply packet sets

up packet kind:course maintenance reply, address:AP, and contiguity:WR2, hop number:2, transmitting agency:WR5, sending agency:WR5, and normal course:WR5, and is transmitted to node WR2.
[0039]The packet-kind:course maintenance reply of the course maintenance reply packet which received node WR2, address:AP, contiguity: AP and hop number:1, transmitting agency:WR2, sending agency:WR2, normal course:WR2, and WR5 are set up, and it is transmitted to particular node AP.
[0040]Particular node AP takes out normal course WR2 and WR5 from the course maintenance reply packet which received, and changes each course check corresponding to address WR2 of a course control table, and WR5 into O.K. out of course investigation. If specified time elapse of particular node AP is carried out after transmitting a route maintaining packet, it will investigate each course check of a course control table, and will reconstruct a course to the course of address WR7 under course investigation (drawing 5, s35).
[0041](The 2nd control sequence led by AP: Claims 2 and 8) The 2nd control sequence led by AP is explained with reference to drawing 8 - drawing 11. Drawing 8 shows the control sequence of particular node AP. Drawing 9 shows the control sequence in the nodes WR1-WR7. Drawing 10 shows the example of composition of a route maintaining packet. Drawing 11 shows the example of composition of a course maintenance reply packet.
[0042]A route maintaining packet comprises packet kind, address, contiguity, hop number, and transmitting origin and a sending agency, as shown in drawing 10. Here, :AP and dispatch origin is set [maximum / of the hop number of packet kind:course maintenance, address:broadcasting, contiguity:broadcasting, and a hop number:course control table / (3), and transmitting origin] as :AP.
[0043]In drawing 2 and 8, particular node AP sets up the course check to each course of a course control table during course investigation (s41), broadcasts the route maintaining packet shown in drawing 10 which set the transmitting agency to AP (s42), and goes into the receiving waiting of a course maintenance reply packet (s43).
[0044]In drawing 9, if node WR1 is in the state of the waiting for reception of a route maintaining packet (s51) and the route maintaining packet from particular node AP is received in predetermined time (s52), the dispatch origin of a route maintaining packet will be checked (s53). and the dispatch origin of the contiguity to address AP of the course control table of node WR1 and a route maintaining packet is in agreement -- it is (here both AP) -- case (s54) A course maintenance reply packet is transmitted to particular node AP which is a sending agency (s55). A course maintenance reply packet comprises packet kind, address, contiguity, hop number, and transmitting origin and a sending agency, as shown in drawing 11. Here, it is set as packet kind:course maintenance reply, address:AP, contiguity:AP, and hop number:1, transmitting agency:WR1, and sending agency:WR1.
[0045]Node WR1 broadcasts the route maintaining packet set as the self-node the sending agency (s56). As for packet kind:course maintenance, address:broadcasting, contiguity:broadcasting, hop number:2, and transmitting origin, this route maintaining packet is set as :AP and sending agency:WR1.
[0046]While other nodes which received this route maintaining packet are processed similarly and transmit to course maintenance reply packet dispatch-origin, respectively, a route maintaining packet is broadcast. However, since the hop number of the route maintaining packet from node WR4 is 1, node WR3, WR6, and WR7 do not broadcast a route maintaining packet. In each node which received the course maintenance reply packet, à course maintenance reply packet is transmitted to addressing to a node of the contiguity to address AP of a course control table one by one, and particular node AP is reached eventually.
[0047]In drawing 8, particular node AP takes out transmitting agency WR1 of the course maintenance reply packet which received in predetermined time, and changes each course check corresponding to address WR1 of a course control table into O.K. out of course investigation (s44, s45). The same may be said of the course maintenance reply packet from other transmitting origin. If specified time elapse of particular node AP is carried out after broadcasting a route maintaining packet, it will investigate each course check of a course control table, and will reconstruct a course to the course of the address under course investigation (s46).
[0048](Processing at the time of the fault occurrence between WR5 and WR7: Claims 5 and 11) When an obstacle occurs between WR5 and WR7, Since a course maintenance reply packet is replied to particular node AP about the nodes WR1-WR6, each course check of the course control table of particular node AP is O.K. However, since the course maintenance reply packet from node WR7 does

not reach particular node AP, a corresponding course check continues course being under investigation. Therefore, if specified time elapse of particular node AP is carried out after broadcasting a route maintaining packet, it will investigate each course check of a course control table, and will reconstruct a course to the course of address WR7 under course investigation.
[0049]The embodiment of <WR initiative: Claims 3, 4, 6, 9, and 10 and 12> drawing 12 show the course control table of the nodes WR1-WR7 in WR initiative. The composition of a wireless network and the course control table of particular node AP are the same as what is shown in drawing 1.
[0050]In the course control table of the nodes WR1-WR7, the column of a "course check" other than an "address", "contiguity", and a "hop number" is provided. A "course check" means whether each node received the route maintaining packet in predetermined time by the confirmation of receipt of a course maintenance reply packet.
[0051](The 1st control sequence of WR initiative: Claims 3 and 9) The 1st control sequence of WR initiative is explained with reference to drawing 13. Drawing 13 shows the control sequence in the nodes WR1-WR7. Here, although the case of node WR6 is explained, the same may be said of other node WR3 and WR7.
[0052]In drawing 12 and 13, since it does not receive the route maintaining packet addressed to particular node AP even if it carries out specified time elapse of node WR6 (s61), it generates the route maintaining packet addressed to particular node AP, and transmits to addressing to node WR4 of contiguity based on a course control table (s62). This route maintaining packet, a packet kind: It is set as course maintenance, address:AP, and contiguity:WR4, hop number:3, transmitting agency:WR6, and sending agency:WR6. And it goes into the receiving waiting of a course maintenance reply packet (s63).

[0053]If the route maintaining packet addressed to particular node AP is received from node WR6 in predetermined time (s61), node WR4 will search the adjacent node to address AP from a course control table, and it will transmit a route maintaining packet to node WR1 here (s64). As for this route maintaining packet, setting out is changed into packet kind:course maintenance, address:AP, and contiguity:WR1, hop number:2, transmitting agency:WR6, and sending agency:WR4. And it goes into the receiving waiting of a course maintenance reply packet (s65).
[0054]If the route maintaining packet addressed to particular node AP is received from node WR4 in predetermined time, node WR1 will be processed like node WR4 and it will transmit a route maintaining packet to particular node AP. As for this route maintaining packet, setting out is changed into packet kind:course maintenance, address:AP, contiguity:AP, and hop number:1, transmitting agency:WR6, and sending agency:WR1.
[0055]If a route maintaining packet is received from node WR1, particular node AP will take out transmitting agency WR6 from a route maintaining packet, and will transmit a course maintenance reply packet to node WR1 of the contiguity obtained from the course control table by making node WR6 into an address. As for :AP and dispatch origin, this course maintenance reply packet is set [packet kind:course maintenance reply, address:WR6, contiguity:WR1, hop number:3, and transmitting origin] as :AP.
[0056]Node WR1 is contained in the receiving waiting of a course maintenance reply packet (s65), Into predetermined time, it recognizes that the course to particular node AP is normal in receiving the course maintenance reply packet addressed to node WR6 from particular node AP, and the course check of address AP of a course control table is set to O.K. (s66). And node WR1 makes node WR6 an address and a course maintenance reply packet is transmitted to node WR4 of the contiguity obtained from the course control table (s67). As for this course maintenance reply packet, as for packet kind:course maintenance reply, address:WR6, contiguity:WR4, hop number:2, and transmitting origin, setting out is changed into :AP and sending agency:WR1.
[0057]If the course maintenance reply packet addressed to node WR1 to node WR6 is received in predetermined time, node WR4 will recognize that the course to particular node AP is normal, and it will set address AP of a course control table, and the course check of WR1 to O.K. And it processes like node WR1 and a course maintenance reply packet is transmitted to node WR6. As for this course maintenance reply packet, as for packet kind:course maintenance, address:WR6, contiguity:WR6, hop number:1, and transmitting origin, setting out is changed into :AP and sending agency:WR4.
[0058]Node WR6 recognizes that the course to particular node AP is normal in going into the receiving

waiting of the course maintenance reply packet (s63), and receiving a course maintenance reply packet from node WR4 in predetermined time, and it sets address AP of a course control table, and the course check of WR4 to O.K. (s68). Since the address is a self-node at this time, processing is ended without transmitting a course maintenance reply packet.
[0059](Processing at the time of the fault occurrence between WR2 and WR5: Claims 6 and 12) In drawing 12 and 13, node WR5, A route maintaining packet is received from node WR7, a route maintaining packet is transmitted to node WR2 according to the procedure mentioned above, and it goes into the reception waiting state of a course maintenance reply packet (s65). even if it carries out specified time elapse, a course maintenance reply packet is not replied from node WR2 here (s66). When specified time elapse is carried out without the fault notification packet mentioned later also receiving (s69, s70) If the fault notification packet which received is transmitted from the direction of particular node AP (an address is contiguity of AP) (s71), a fault notification packet will be broadcast by one hop. (s72). This fault notification packet is set as packet kind:fault information, address:broadcasting, contiguity:broadcasting, hop number:1, transmitting agency:WR5, and sending agency:WR5. And contiguity of a course control table deletes setting out of the course of WR2 (s73).
[0060]Node WR7 receives not a course maintenance reply packet but a fault notification packet, The case (s75) where both the dispatch origin of the contiguity to address AP of a course control table and a fault notification packet is in agreement by WR5, If specified time elapse is carried out, with both packets not received (s76), a fault notification packet will be broadcast by one hop (s72), and setting out of the course to particular node AP will be deleted (s73). This fault notification packet is set as packet kind:fault information, address:broadcasting, contiguity:broadcasting, hop number:1, transmitting agency:WR5, and sending agency:WR7.
[0061]Since the contiguity to address AP of a course control table is WR1 and the dispatch origin of node WR4 of a fault notification packet does not correspond by WR5 if a fault notification packet is received, this fault notification packet is disregarded.
[0062]reconstruction of a course [as opposed to / in node WR5 and WR7 / particular node AP by the above] -- carrying out (s74) -- the method may use course constructing methods by above-mentioned this invention, such as a method and the conventional AODV.
[0063](The 2nd control sequence of WR initiative: Claims 4 and 10) The 2nd control sequence of WR initiative is explained with reference to drawing 14. Drawing 14 shows the control sequence in the nodes WR1-WR7. Here, although the case of node WR5 is explained, it is the same about other nodes.
[0064]Drawing 12 and 14 (1) It sets, and if node WR5 becomes a certain time, it will carry out all the course checks of a course control table during course investigation (s81). And a route maintaining packet is generated and it broadcasts by one hop. (s82). This route maintaining packet is set as packet kind:course maintenance, address:broadcasting, contiguity:broadcasting, hop number:1, transmitting agency:WR5, and sending agency:WR5. And it goes into the receiving waiting of a course maintenance reply packet (s83).
[0065]Drawing 14 (2) If it sets and node WR2 receives a route maintaining packet (s91), a course maintenance reply packet will be generated and it will transmit to addressing to node WR5 which transmitted the route maintaining packet (s92). This course maintenance reply packet is set as a packet kind:course maintenance reply, address:WR5, contiguity:WR5, hop number:1, transmitting agency:WR2, and sending agency:WR2. Node WR4 which receives a route maintaining packet, and WR7 are the same.
[0066]Drawing 14 (1) It sets, and if node WR5 in the receiving waiting of a course maintenance reply packet receives the course maintenance reply packet from node WR2, WR4, and WR7 in predetermined time (s84), it will set it as O.K. of the course check of contiguity WR2 of a course control table, WR4, and WR7 (s85).
[0067](Processing at the time of the fault occurrence between WR2 and WR5: Claims 6 and 12) Drawing 12 and drawing 14 (1) Set and node WR5, The course maintenance reply packet from node WR2 is not received in predetermined time (s84), but if it recognizes that the obstacle occurred between node WR2 from the course check of a course control table continuing investigating a course, contiguity of a course control table will change the course of WR2 during course construction (s86). Since the course under course construction is the direction of particular node AP, a fault notification packet is broadcast by one hop. (s87). This fault notification packet is set as packet kind:fault

information, address:broadcasting, contiguity:broadcasting, hop number:1, transmitting agency:WR5, and sending agency:WR5. reconstruction of a course [as opposed to / by this / particular node AP in node WR5] -- carrying out (s88) -- the method may use course constructing methods by above-mentioned this invention, such as a method and the conventional AODV.

[0068]Drawing 14 (3) Set and node WR7 receives a fault notification packet (s93), When both the dispatch origin of the contiguity to address AP of a course control table and a fault notification packet is in agreement by WR5, contiguity of (s94) and a course control table changes the course of WR2 during course construction (s95), and broadcasts a fault notification packet by one hop (s96). This fault notification packet is set as packet kind:fault information, address:broadcasting, contiguity:broadcasting, hop number:1, transmitting agency:WR5, and sending agency:WR7. reconstruction of a course [as opposed to / by this / particular node AP in node WR7] -- carrying out (s97) -- the method may use course constructing methods by above-mentioned this invention, such as a method and the conventional AODV.

[0069]Since the contiguity to address AP of a course control table is WR1 and the dispatch origin of node WR4 of a fault notification packet does not correspond by WR5 if a fault notification packet is received, this fault notification packet is disregarded.

[0070]

[Effect of the Invention]In the wireless network with little [as explained above] access between other wireless nodes in which this invention accesses frequently a wireless node with each specific wireless node, In a specific wireless node, as opposed to each wireless node, each wireless node transmits a route maintaining packet by a unicast to a specific wireless node, The node which received the route maintaining packet can carry out unicast transmission of the course maintenance reply packet, and the transmission node of a route maintaining packet can maintain the course between a specific wireless node and each wireless node by the confirmation of receipt of a course maintenance reply packet. Therefore, to course maintenance with a specific wireless node, delay accompanying course maintenance can be made small and the futility of the non-line zone region in accordance with useless course construction processing, the processings for course maintenance, and these processings can be excluded.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention]Each wireless node accesses a specific wireless node frequently, and this invention relates to the course maintenance method, course maintaining system, and wireless node device which perform course maintenance with a specific wireless node in a wireless network with little access between other wireless nodes.

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PRIOR ART

[Description of the Prior Art]The conventional course management about the packet transfer between the wireless nodes (henceforth a "node") in a wireless network, There are a table drive system which always builds the course, a method on demand which builds a transfer path when the necessity for communication arises, and a hybrid system which combined the table drive system and the method on demand.
[0003]Since channel information is notified to each node, each node reconstructs a course based on the information and a table drive system maintains a course when each node is periodical or detects change of topology, when communication arises, it can start transmission of a packet immediately. However, in the communication configuration accessed frequently [a specific node] from many nodes, the processing and communication for unnecessary course construction arise.
[0004]On the other hand, a method on demand, For example, literature. (Charles E. Perkins, "Ad Hoc On-Demand Distance Vector Routing", in Proceedings of the 2nd IEEE Workshopon Mobile Computing) In Systems and Applications, pp.90-100, and AODV (Ad Hoc On-Demand Distance Vector Routing) proposed by 1999. When communication arises, a path planning packet is broadcast to the whole network, and course construction is attained when a destination node etc. return the reply. Therefore, although it becomes unnecessary [the processing for course maintenance] to a specific course, delay after communication arises until the first data packet is transmitted is not avoided. Since communication is impossible if the adjacent node which is in the range in which direct communication is possible in a radio link cannot be recognized, a route maintaining packet is broadcast to the adjacent node in the range in which direct communication is possible. Although the node which received this route maintaining packet recognizes an adjacent node (transmission node) by receiving a route maintaining packet, if this route maintaining packet is not received fixed time, it recognizes that change of the topology by an obstacle etc. broke out. For this reason, by the time it recognizes that change of topology broke out, the time beyond this fixed time will be needed.
[0005]A hybrid system, For example, literature. Zygmunt J. Hass,"A New Routing Protocol for the Reconfigurable Wireless Networks", in IEEE ICUPC'97,pp.652-566. In ZRP (Zone Routing Protocol) proposed by 1997. The concept of a zone radius is introduced, and each node manages the course to the node in a zone radius with a table drive system, and suppose that the course to the node besides a zone radius is built by a method on demand. For this reason, if a zone radius is set up a specific node come in a zone radius, in the communication configuration accessed frequently [a specific node] from many nodes, the processing and communication for unnecessary course construction will arise like a table drive system. When a zone radius is set up a specific node come out of a zone radius on the other hand, in the communication configuration in which a specific node is frequently accessed from many nodes, delay will always arise like a method on demand.

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EFFECT OF THE INVENTION

[Effect of the Invention]In the wireless network with little [as explained above] access between other wireless nodes in which this invention accesses frequently a wireless node with each specific wireless node, In a specific wireless node, as opposed to each wireless node, each wireless node transmits a route maintaining packet by a unicast to a specific wireless node, The node which received the route maintaining packet can carry out unicast transmission of the course maintenance reply packet, and the transmission node of a route maintaining packet can maintain the course between a specific wireless node and each wireless node by the confirmation of receipt of a course maintenance reply packet. Therefore, to course maintenance with a specific wireless node, delay accompanying course maintenance can be made small and the futility of the non-line zone region in accordance with useless course construction processing, the processings for course maintenance, and these processings can be excluded.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]By the way, since the specific node used as a gateway with an external network will be frequently accessed from many nodes, the above problems arise in such a communication configuration.
[0007]That is, in the conventional table drive system, if it is necessary to have the channel information over all the nodes and an obstacle etc. detect change of topology, it is necessary to notify the detected node to all the nodes for reconstruction of a course, and each node needs to reconstruct a course based on this notice. Thus, the non-line zone region where the access frequency to "a specific node" follows maintaining the course of all the nodes on the course construction processing of those other than "a specific node", the processings for course maintenance, and these processings in a high system becomes useless.
[0008]In the communication configuration in which a specific node is frequently accessed from many nodes instead of [which does not need to perform course maintenance], delay will always produce the conventional method on demand. Especially each node only transmits a route maintaining packet only to an adjacent node, did not receive the reply of the route maintaining packet from an adjacent node, and was not able to check whether the adjacent node would have received the route maintaining packet. Therefore, since it could not be coped with but change of topology needed to be recognized by another means when it cannot transmit to an adjacent node, although it could receive from the adjacent node, by the time it has recognized change of topology and reconstructed the course, time was taken, and delay was large.
[0009]Since the conventional hybrid system changes a table drive system and a method on demand with the distance from a node, it has each problem of the conventional table drive system and a method on demand as it is.
[0010]In the wireless network with little access between other nodes in which this invention accesses a node with each specific node frequently, To course maintenance with a specific node, it is delayed small, and aims at providing the course maintenance method, course maintaining system, and wireless node device which can exclude the futility of the non-line zone region in accordance with useless course construction processing, the processings for course maintenance, and these processings.

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MEANS

[Means for Solving the Problem]A course maintenance method in a wireless network, a course maintaining system, and a wireless node device of this invention, In a specific wireless node, as opposed to each wireless node, each wireless node transmits a route maintaining packet to a specific wireless node, A node which received a route maintaining packet transmits a course maintenance reply packet, and a transmission node of a route maintaining packet maintains a course between a specific wireless node and each wireless node by the confirmation of receipt of a course maintenance reply packet.
[0012]By invention of a statement, to claims 1, 7, 13, and 14. A specific wireless node holds a course control table in which an "address", "contiguity", a "hop number", and a "course check" were described, an "address" which makes "contiguity" the same -- a route maintaining packet which indicated all, [generate and] It checks carrying out the unicast of this route maintaining packet to a wireless node applicable to "contiguity", receiving a course maintenance reply packet which a wireless node which received a route maintaining packet transmitted, and maintaining each course.
[0013]When a wireless node holds a course control table in which an "address", "contiguity", and a "hop number" were described and a route maintaining packet is received, Take out all the "addresses" described by this route maintaining packet, and a route maintaining packet which indicated all the the "addresses" which makes "contiguity" of a course control table the same to that "address" is generated, Unicast relay of this route maintaining packet is carried out to a wireless node applicable to "contiguity", When a route maintaining packet does not need to be relayed, or when specified time elapse of the route maintaining packet is relayed and carried out, A course maintenance reply packet to a specific wireless node is generated, unicast transmission is carried out, when a course maintenance reply packet is received, information which shows that a route maintaining packet was received by a self-node is added to the course maintenance reply packet, and unicast relay is carried out.
[0014]By invention of a statement, to claims 2, 8, 13, and 14. A specific wireless node holds a course control table in which an "address", "contiguity", a "hop number", and a "course check" were described, It checks generating a route maintaining packet, broadcasting this route maintaining packet to an adjoining wireless node which is in a range in which direct communication is possible in a radio link, receiving a course maintenance reply packet transmitted from a wireless node which received a route maintaining packet, and maintaining each course.
[0015]When a wireless node holds a course control table in which an "address", "contiguity", and a "hop number" were described and a route maintaining packet is received, The dispatch origin is checked, and in being the first route maintaining packet from a specific wireless node, a course maintenance reply packet to a specific wireless node is generated, and it carries out unicast transmission.
[0016]By invention of a statement, to claims 3, 9, 13, and 14. A wireless node holds a course control table in which an "address", "contiguity", a "hop number", and a "course check" were described, Generate a route maintaining packet at predetermined time, and a unicast is carried out to a specific wireless node, Add information which can identify a self-node uniquely when a route maintaining packet is received to a route maintaining packet, and it hooks up to a specific wireless node, If a course maintenance reply packet which a specific wireless node transmitted is received, a course with a

specific wireless node will be recorded on a course control table, when this course maintenance reply packet is addressing to a self-node, it is discarded, and in addressing to a wireless node of others, it is relayed.
[0017]When a specific wireless node holds a course control table in which an "address", "contiguity", and a "hop number" were described and a route maintaining packet is received, Information on a wireless node which passed from this route maintaining packet is taken out, that channel information is recorded on a course control table, a transmitting agency is taken out from a route maintaining packet, and the unicast of the course maintenance reply packet is carried out to that transmitting origin.
[0018]By invention of a statement, to claims 4, 10, 13, and 14. A wireless node holds a course control table in which an "address", "contiguity", a "hop number", and a "course check" were described, It broadcasts to a wireless node which generates a route maintaining packet and adjoins predetermined time, When the unicast of the course maintenance reply packet is carried out to the transmitting origin when a route maintaining packet is received, and a course maintenance reply packet cannot be received from an adjoining wireless node, information corresponding to the adjoining wireless node is deleted from a course control table, and a course is reconstructed.
[0019]In an invention given in claims 5, 11, and 13, about predetermined time which reception of a packet used for a "course check" described in a course control table takes, a specific wireless node reconstructs a course between wireless nodes, when a packet is not sent in the predetermined time from a wireless node.
[0020]By invention of a statement, to claims 6, 12, and 14, a wireless node, After transmitting a packet to other wireless nodes in a course based on a course control table, even if it carries out specified time elapse, when there is no reply packet, The same course as "contiguity" of a course which does not have a reply packet among "contiguity" described in a course control table is deleted, a fault notification packet is broadcast to an adjoining wireless node which is in a range in which direct communication is possible in a radio link, and a course between wireless nodes is reconstructed.
[0021]
[Embodiment of the Invention]Drawing 1 shows the example of composition of a wireless network. In a figure, the specific node used as a gateway with an external network is set to AP (access point), Node WR1 and WR2 are connected to particular node AP via a radio link, Furthermore node WR1 and node WR4 are connected, node WR4, node WR3, WR5, WR6, and WR7 are connected, node WR2 and node WR5 are connected, the nodes WR5 and WR7 are connected further, and node WR3 and node WR6 are connected.
[0022]The course control table of each node comprises "an address (destination node)", "contiguity (adjacent node transmitted in order to send a packet to a destination node)", and "a hop number (by the time a packet reaches a destination node, it is metric [of a required course])." For example, in particular node AP, it becomes contiguity WR1 and the hop number 1 to address WR1, and becomes contiguity WR1 and the hop number 2 to address WR3. The contiguity at the time of making particular node AP into an address and a hop number are set to the course control table of each node WR 1-7.
[0023]As for this invention, in particular node AP, as opposed to each nodes WR1-WR7, each nodes WR1-WR7 transmit a route maintaining packet to particular node AP, The node which received the route maintaining packet transmits a course maintenance reply packet, and the transmission node of a route maintaining packet maintains the course between particular node AP and each nodes WR1-WR7 by the confirmation of receipt of a course maintenance reply packet. Hereafter, the embodiment led by AP which transmits a route maintaining packet from particular node AP to each nodes WR1-WR7, and the embodiment of WR initiative to which each nodes WR1-WR7 transmit a route maintaining packet to particular node AP are described.
[0024]The embodiment led by <AP: Claims 1, 2, 5, 7, and 8 and 11> drawing 2 show the course control table of particular node AP in led by AP. The composition of a wireless network and the course control table of the nodes WR1-WR7 are the same as what is shown in drawing 1.
[0025]In the course control table of particular node AP, the column of a "course check" other than an "address", "contiguity", and a "hop number" is provided. A "course check" means whether each node received the route maintaining packet in predetermined time by the confirmation of receipt of a course maintenance reply packet.
[0026](The 1st control sequence led by AP: Claims 1 and 7) The 1st control sequence led by AP is

explained with reference to drawing 3 - drawing 7. Drawing 3 shows the control sequence at the time of the route maintaining packet transmission in particular node AP. Drawing 4 shows the control sequence in the nodes WR1-WR7. Drawing 5 shows the control sequence at the time of the course maintenance reply packet reception in particular node AP. Drawing 6 shows the example of composition of a route maintaining packet. Drawing 7 shows the example of composition of a course maintenance reply packet.

[0027](Control sequence at the time of the route maintaining packet transmission in particular node AP) In drawing 2 and 3, if it investigates whether particular node AP has an unsettled group which becomes a course control table from an "address", "contiguity", and a "hop number" and there is an unsettled group, a route maintaining packet will be generated. As for a route maintaining packet, as shown in drawing 6, packet kind, address, contiguity, hop number, and transmitting origin and a sending agency comprise a real address. A real address means the node which should receive a route maintaining packet.

[0028]Here, the groups of the "address" of the course control table of particular node AP, "contiguity", and a "hop number" are described to be [an address, contiguity, and a hop number]. First, as shown in drawing 2, there is a group of [WR1, WR1, 1], and it turns out that an adjacent node is WR1 (s1). The route maintaining packet of contiguity WR1 here by that (it is the first route maintaining packet) not existing (s2), Drawing 6 (1) A route maintaining packet (transmitting [course maintenance, address:WR1, contiguity:WR1, hop number:1, and] origin: packet kind : AP and dispatch origin : AP and real address:WR1) as shown is generated (s3). Next, about [WR2, WR2, 1], the route maintaining packet (transmitting [course maintenance address:WR2, contiguity:WR2, hop number:1, and] origin: packet kind : AP and dispatch origin : AP and real address:WR2) of contiguity WR2 is generated in the similar manner (s3).

[0029]Next, since the route maintaining packet of contiguity WR1 already exists about [WR3, WR1, 3] (s2), WR3 is added to the real address of this route maintaining packet (s4, drawing 6 (2)). Since the route maintaining packet of contiguity WR1 already exists if attached to [WR4, WR1, 2] (s2), WR4 is added to the real address of this route maintaining packet (s4, drawing 6 (3)). The route maintaining packet by the addition of a real address is generated also to [WR5, WR2, 2], [WR6, WR1, 3], and [WR7, WR2, 3] like the following, respectively.

[0030]As for a route maintaining packet, two kinds, WR1 direction and WR 2-way, are generated by the above. As for the route maintaining packets of WR1 direction, :AP and dispatch origin is [packet kind:course maintenance, address:WR1, contiguity:WR1, hop number:1, and transmitting origin] :AP and real address:WR1, WR3, WR4, and WR6 (drawing 6 (4)). On the other hand, as for the route maintaining packets of WR 2-way, :AP and dispatch origin is [packet kind:course maintenance, address:WR2 contiguity:WR2, hop number:1, and transmitting origin] :AP and real address:WR2, WR5, and WR7 (drawing 6 (5)). And the course check of each course is carried out during course investigation, and two kinds of route maintaining packets are transmitted to node WR1 and WR2.

[0031](Control sequence in the nodes WR1-WR7) In drawing 2 and 4, node WR1 reception of a route maintaining packet will investigate whether a real address has nodes other than a self-node (s12). (s11) Here, since a real address has node WR3 other than a self-node, WR4, and WR6, a route maintaining packet is generated according to the course control table of node WR1 (s13-s17). Since it turns out that [WR4, WR4, 1] to contiguity of a course control table is WR4 and the route maintaining packet of contiguity WR4 does not exist to real address WR4, The route maintaining packet (packet kind: course maintenance, address:WR4, contiguity:WR4, hop number:1, real address:WR4) of contiguity WR4 is generated. Since the route maintaining packet of contiguity WR4 already exists if attached to [WR6, WR4, 2], WR6 is added to the real address of this route maintaining packet. It is the same even if attached to [WR3, WR4, 2]. Thereby, node WR1 transmits the route maintaining packet used as packet kind:course maintenance, address:WR4, contiguity:WR4, hop number:1, real address:WR3, WR4, and WR6 to node WR4 (s18), and it becomes the receiving waiting of a course maintenance reply packet (s19).

[0032]Node WR4 will be processed like node WR1, if the route maintaining packet from node WR1 is received. That is, the route maintaining packet used as packet kind:course maintenance, address:WR3, contiguity:WR3, hop number:1, and real address:WR3 is transmitted to node WR3 (s18). The route maintaining packet used as packet kind:course maintenance, address:WR6, contiguity:WR6, hop number:1, and real address:WR6 is transmitted to node WR6 (s18). And it becomes the receiving waiting

of a course maintenance reply packet (s19).
[0033]Since any nodes other than a self-node do not exist in a real address if the route maintaining packet from node WR4 is received (s12), node WR3 generates the course maintenance reply packet to particular node AP which is a transmitting agency, and it replies it to node WR4 (s23, s24). As for a course maintenance reply packet, as shown in drawing 7, packet kind, address, contiguity, hop number, and transmitting origin and a sending agency comprise a normal course. This course maintenance reply packet is set as packet kind:course maintenance reply, address:AP, and contiguity:WR4, hop number:3, transmitting agency:WR3, sending agency:WR3, and normal course:WR3 (drawing 7 (1)). Node WR6 performs the same processing as node WR3.
[0034]Node WR4 is the receiving waiting of the course maintenance reply packet in s19, If a course maintenance reply packet is received from the nodes WR3 and WR6 (s20, s21), the course maintenance reply packet which added the self-node to those normal courses and which newly generated the course maintenance reply packet and received will be canceled. A new course maintenance reply packet is set as packet kind:course maintenance reply, address:AP, and contiguity:WR1, hop number:2, transmitting agency:WR4, sending agency:WR4, normal course:WR3, WR4, and WR6 (drawing 7 (2)), and is transmitted to node WR1 (s22).
[0035]Node WR1 performs the same processing as node WR4. A course maintenance reply packet is set to packet kind:course maintenance reply, address:AP, contiguity:AP, and hop number:1, transmitting agency:WR1, sending agency:WR1, normal course:WR1, WR3, WR4, and WR6 (drawing 7 (3)), and is transmitted to particular node AP.
[0036]About the root of node WR2, WR5, and WR7, similarly From node WR2 to a packet kind:course maintenance reply. Address: The course maintenance reply packet set to AP, contiguity:AP, and hop number:1, transmitting agency:WR2, sending agency:WR2, normal course:WR2, WR5, and WR7 is transmitted to particular node AP.
[0037](Control sequence at the time of the course maintenance reply packet reception in particular node AP) In drawing 2 and 5, After particular node AP transmits two kinds of route maintaining packets to node WR1 and WR2, If it is the receiving waiting of the course maintenance reply packet (s31) and the course maintenance reply packet from node WR1 is received in predetermined time (s32), Normal course WR1, WR3, WR4, and WR6 are taken out from a course maintenance reply packet, and each course check corresponding to address WR1 of a course control table, WR3, WR4, and WR6 is changed into O.K. out of course investigation (s33). The course maintenance reply packet from node WR2 is processed similarly (s34).
[0038](Processing at the time of the fault occurrence between WR5 and WR7: Claims 5 and 11) In drawing 2, node WR5 transmits a route maintaining packet to node WR7 according to the procedure which received and mentioned the route maintaining packet above from node WR2, and it goes into the reception waiting state of a course maintenance reply packet (drawing 4, s19). Here, even if it carries out specified time elapse, when a course maintenance reply packet is not received from node WR7, node WR5 generates a course maintenance reply packet. This course maintenance reply packet sets up packet kind:course maintenance reply, address:AP, and contiguity:WR2, hop number:2, transmitting agency:WR5, sending agency:WR5, and normal course:WR5, and is transmitted to node WR2.
[0039]The packet-kind:course maintenance reply of the course maintenance reply packet which received node WR2, address:AP, contiguity: AP and hop number:1, transmitting agency:WR2, sending agency:WR2, normal course:WR2, and WR5 are set up, and it is transmitted to particular node AP.
[0040]Particular node AP takes out normal course WR2 and WR5 from the course maintenance reply packet which received, and changes each course check corresponding to address WR2 of a course control table, and WR5 into O.K. out of course investigation. If specified time elapse of particular node AP is carried out after transmitting a route maintaining packet, it will investigate each course check of a course control table, and will reconstruct a course to the course of address WR7 under course investigation (drawing 5, s35).
[0041](The 2nd control sequence led by AP: Claims 2 and 8) The 2nd control sequence led by AP is explained with reference to drawing 8 - drawing 11. Drawing 8 shows the control sequence of particular node AP. Drawing 9 shows the control sequence in the nodes WR1-WR7. Drawing 10 shows the example of composition of a route maintaining packet. Drawing 11 shows the example of composition of a course maintenance reply packet.

[0042]A route maintaining packet comprises packet kind, address, contiguity, hop number, and transmitting origin and a sending agency, as shown in drawing 10. Here, :AP and dispatch origin is set [maximum / of the hop number of packet kind:course maintenance, address:broadcasting, contiguity:broadcasting, and a hop number:course control table / (3), and transmitting origin] as :AP.
[0043]In drawing 2 and 8, particular node AP sets up the course check to each course of a course control table during course investigation (s41), broadcasts the route maintaining packet shown in drawing 10 which set the transmitting agency to AP (s42), and goes into the receiving waiting of a course maintenance reply packet (s43).
[0044]In drawing 9, if node WR1 is in the state of the waiting for reception of a route maintaining packet (s51) and the route maintaining packet from particular node AP is received in predetermined time (s52), the dispatch origin of a route maintaining packet will be checked (s53). and the dispatch origin of the contiguity to address AP of the course control table of node WR1 and a route maintaining packet is in agreement -- it is (here both AP) -- case (s54) A course maintenance reply packet is transmitted to particular node AP which is a sending agency (s55). A course maintenance reply packet comprises packet kind, address, contiguity, hop number, and transmitting origin and a sending agency, as shown in drawing 11. Here, it is set as packet kind:course maintenance reply, address:AP, contiguity:AP, and hop number:1, transmitting agency:WR1, and sending agency:WR1.
[0045]Node WR1 broadcasts the route maintaining packet set as the self-node the sending agency (s56). As for packet kind:course maintenance, address:broadcasting, contiguity:broadcasting, hop number:2, and transmitting origin, this route maintaining packet is set as :AP and sending agency:WR1.
[0046]While other nodes which received this route maintaining packet are processed similarly and transmit to course maintenance reply packet dispatch-origin, respectively, a route maintaining packet is broadcast. However, since the hop number of the route maintaining packet from node WR4 is 1, node WR3, WR6, and WR7 do not broadcast a route maintaining packet. In each node which received the course maintenance reply packet, a course maintenance reply packet is transmitted to addressing to a node of the contiguity to address AP of a course control table one by one, and particular node AP is reached eventually.
[0047]In drawing 8, particular node AP takes out transmitting agency WR1 of the course maintenance reply packet which received in predetermined time, and changes each course check corresponding to address WR1 of a course control table into O.K. out of course investigation (s44, s45). The same may be said of the course maintenance reply packet from other transmitting origin. If specified time elapse of particular node AP is carried out after broadcasting a route maintaining packet, it will investigate each course check of a course control table, and will reconstruct a course to the course of the address under course investigation (s46).
[0048](Processing at the time of the fault occurrence between WR5 and WR7: Claims 5 and 11) When an obstacle occurs between WR5 and WR7, Since a course maintenance reply packet is replied to particular node AP about the nodes WR1-WR6, each course check of the course control table of particular node AP is O.K. However, since the course maintenance reply packet from node WR7 does not reach particular node AP, a corresponding course check continues course being under investigation. Therefore, if specified time elapse of particular node AP is carried out after broadcasting a route maintaining packet, it will investigate each course check of a course control table, and will reconstruct a course to the course of address WR7 under course investigation.
[0049]The embodiment of <WR initiative: Claims 3, 4, 6, 9, and 10 and 12> drawing 12 show the course control table of the nodes WR1-WR7 in WR initiative. The composition of a wireless network and the course control table of particular node AP are the same as what is shown in drawing 1.
[0050]In the course control table of the nodes WR1-WR7, the column of a "course check" other than an "address", "contiguity", and a "hop number" is provided. A "course check" means whether each node received the route maintaining packet in predetermined time by the confirmation of receipt of a course maintenance reply packet.
[0051](The 1st control sequence of WR initiative: Claims 3 and 9) The 1st control sequence of WR initiative is explained with reference to drawing 13. Drawing 13 shows the control sequence in the nodes WR1-WR7. Here, although the case of node WR6 is explained, the same may be said of other node WR3 and WR7.
[0052]In drawing 12 and 13, since it does not receive the route maintaining packet addressed to

particular node AP even if it carries out specified time elapse of node WR6 (s61), it generates the route maintaining packet addressed to particular node AP, and transmits to addressing to node WR4 of contiguity based on a course control table (s62). This route maintaining packet, a packet kind: It is set as course maintenance, address:AP, and contiguity:WR4, hop number:3, transmitting agency:WR6, and sending agency:WR6. And it goes into the receiving waiting of a course maintenance reply packet (s63).

[0053]If the route maintaining packet addressed to particular node AP is received from node WR6 in predetermined time (s61), node WR4 will search the adjacent node to address AP from a course control table, and it will transmit a route maintaining packet to node WR1 here (s64). As for this route maintaining packet, setting out is changed into packet kind:course maintenance, address:AP, and contiguity:WR1, hop number:2, transmitting agency:WR6, and sending agency:WR4. And it goes into the receiving waiting of a course maintenance reply packet (s65).
[0054]If the route maintaining packet addressed to particular node AP is received from node WR4 in predetermined time, node WR1 will be processed like node WR4 and it will transmit a route maintaining packet to particular node AP. As for this route maintaining packet, setting out is changed into packet kind:course maintenance, address:AP, contiguity:AP, and hop number:1, transmitting agency:WR6, and sending agency:WR1.
[0055]If a route maintaining packet is received from node WR1, particular node AP will take out transmitting agency WR6 from a route maintaining packet, and will transmit a course maintenance reply packet to node WR1 of the contiguity obtained from the course control table by making node WR6 into an address. As for :AP and dispatch origin, this course maintenance reply packet is set [packet kind:course maintenance reply, address:WR6, contiguity:WR1, hop number:3, and transmitting origin] as :AP.
[0056]Node WR1 is contained in the receiving waiting of a course maintenance reply packet (s65), Into predetermined time, it recognizes that the course to particular node AP is normal in receiving the course maintenance reply packet addressed to node WR6 from particular node AP, and the course check of address AP of a course control table is set to O.K. (s66). And node WR1 makes node WR6 an address and a course maintenance reply packet is transmitted to node WR4 of the contiguity obtained from the course control table (s67). As for this course maintenance reply packet, as for packet kind:course maintenance reply, address:WR6, contiguity:WR4, hop number:2, and transmitting origin, setting out is changed into :AP and sending agency:WR1.
[0057]If the course maintenance reply packet addressed to node WR1 to node WR6 is received in predetermined time, node WR4 will recognize that the course to particular node AP is normal, and it will set address AP of a course control table, and the course check of WR1 to O.K. And it processes like node WR1 and a course maintenance reply packet is transmitted to node WR6. As for this course maintenance reply packet, as for packet kind:course maintenance, address:WR6, contiguity:WR6, hop number:1, and transmitting origin, setting out is changed into :AP and sending agency:WR4.
[0058]Node WR6 recognizes that the course to particular node AP is normal in going into the receiving waiting of the course maintenance reply packet (s63), and receiving a course maintenance reply packet from node WR4 in predetermined time, and it sets address AP of a course control table, and the course check of WR4 to O.K. (s68). Since the address is a self-node at this time, processing is ended without transmitting a course maintenance reply packet.
[0059](Processing at the time of the fault occurrence between WR2 and WR5: Claims 6 and 12) In drawing 12 and 13, node WR5, A route maintaining packet is received from node WR7, a route maintaining packet is transmitted to node WR2 according to the procedure mentioned above, and it goes into the reception waiting state of a course maintenance reply packet (s65). even if it carries out specified time elapse, a course maintenance reply packet is not replied from node WR2 here (s66). When specified time elapse is carried out without the fault notification packet mentioned later also receiving (s69, s70) If the fault notification packet which received is transmitted from the direction of particular node AP (an address is contiguity of AP) (s71), a fault notification packet will be broadcast by one hop. (s72). This fault notification packet is set as packet kind:fault information, address:broadcasting, contiguity:broadcasting, hop number:1, transmitting agency:WR5, and sending agency:WR5. And contiguity of a course control table deletes setting out of the course of WR2 (s73).
[0060]Node WR7 receives not a course maintenance reply packet but a fault notification packet, The

case (s75) where both the dispatch origin of the contiguity to address AP of a course control table and a fault notification packet is in agreement by WR5, If specified time elapse is carried out, with both packets not received (s76), a fault notification packet will be broadcast by one hop (s72), and setting out of the course to particular node AP will be deleted (s73). This fault notification packet is set as packet kind:fault information, address:broadcasting, contiguity:broadcasting, hop number:1, transmitting agency:WR5, and sending agency:WR7.
[0061]Since the contiguity to address AP of a course control table is WR1 and the dispatch origin of node WR4 of a fault notification packet does not correspond by WR5 if a fault notification packet is received, this fault notification packet is disregarded.
[0062]reconstruction of a course [as opposed to / in node WR5 and WR7 / particular node AP by the above] -- carrying out (s74) -- the method may use course constructing methods by above-mentioned this invention, such as a method and the conventional AODV.
[0063](The 2nd control sequence of WR initiative: Claims 4 and 10) The 2nd control sequence of WR initiative is explained with reference to drawing 14. Drawing 14 shows the control sequence in the nodes WR1-WR7. Here, although the case of node WR5 is explained, it is the same about other nodes.
[0064]Drawing 12 and 14 (1) It sets, and if node WR5 becomes a certain time, it will carry out all the course checks of a course control table during course investigation (s81). And a route maintaining packet is generated and it broadcasts by one hop. (s82). This route maintaining packet is set as packet kind:course maintenance, address:broadcasting, contiguity:broadcasting, hop number:1, transmitting agency:WR5, and sending agency:WR5. And it goes into the receiving waiting of a course maintenance reply packet (s83).
[0065]Drawing 14 (2) If it sets and node WR2 receives a route maintaining packet (s91), a course maintenance reply packet will be generated and it will transmit to addressing to node WR5 which transmitted the route maintaining packet (s92). This course maintenance reply packet is set as a packet kind:course maintenance reply, address:WR5, contiguity:WR5, hop number:1, transmitting agency:WR2, and sending agency:WR2. Node WR4 which receives a route maintaining packet, and WR7 are the same.
[0066]Drawing 14 (1) It sets, and if node WR5 in the receiving waiting of a course maintenance reply packet receives the course maintenance reply packet from node WR2, WR4, and WR7 in predetermined time (s84), it will set it as O.K. of the course check of contiguity WR2 of a course control table, WR4, and WR7 (s85).
[0067](Processing at the time of the fault occurrence between WR2 and WR5: Claims 6 and 12) Drawing 12 and drawing 14 (1) Set and node WR5, The course maintenance reply packet from node WR2 is not received in predetermined time (s84), but if it recognizes that the obstacle occurred between node WR2 from the course check of a course control table continuing investigating a course, contiguity of a course control table will change the course of WR2 during course construction (s86). Since the course under course construction is the direction of particular node AP, a fault notification packet is broadcast by one hop. (s87). This fault notification packet is set as packet kind:fault information, address:broadcasting, contiguity:broadcasting, hop number:1, transmitting agency:WR5, and sending agency:WR5. reconstruction of a course [as opposed to / by this / particular node AP in node WR5] -- carrying out (s88) -- the method may use course constructing methods by above-mentioned this invention, such as a method and the conventional AODV.
[0068]Drawing 14 (3) Set and node WR7 receives a fault notification packet (s93), When both the dispatch origin of the contiguity to address AP of a course control table and a fault notification packet is in agreement by WR5, contiguity of (s94) and a course control table changes the course of WR2 during course construction (s95), and broadcasts a fault notification packet by one hop (s96). This fault notification packet is set as packet kind:fault information, address:broadcasting, contiguity:broadcasting, hop number:1, transmitting agency:WR5, and sending agency:WR7. reconstruction of a course [as opposed to / by this / particular node AP in node WR7] -- carrying out (s97) -- the method may use course constructing methods by above-mentioned this invention, such as a method and the conventional AODV.
[0069]Since the contiguity to address AP of a course control table is WR1 and the dispatch origin of node WR4 of a fault notification packet does not correspond by WR5 if a fault notification packet is received, this fault notification packet is disregarded.

[Translation done.]

DESCRIPTION OF DRAWINGS

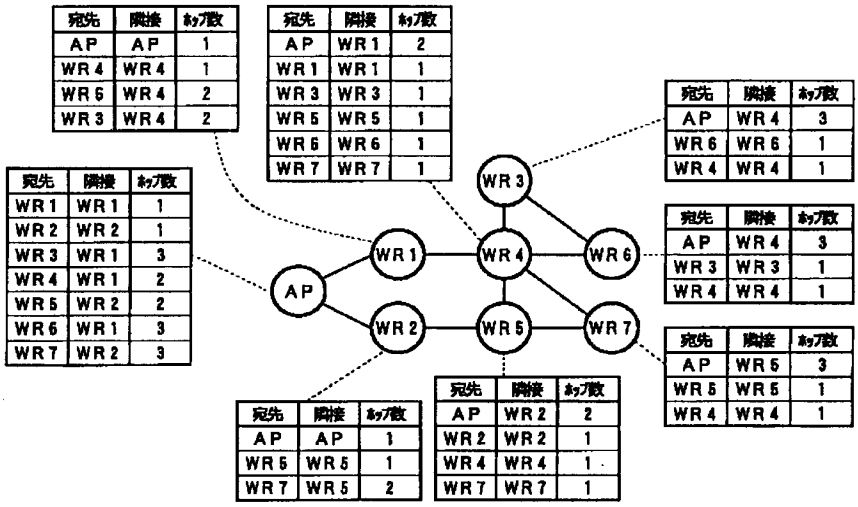
[Brief Description of the Drawings]
[Drawing 1]The figure showing the example of composition of a wireless network.
[Drawing 2]The figure showing the course control table of particular node AP in led by AP.
[Drawing 3]The figure showing the control sequence at the time of the route maintaining packet transmission in particular node AP.
[Drawing 4]The figure showing the control sequence in the nodes WR1-WR7.
[Drawing 5]The figure showing the control sequence at the time of the course maintenance reply packet reception in particular node AP.
[Drawing 6]The figure showing the example of composition of a route maintaining packet.
[Drawing 7]The figure showing the example of composition of a course maintenance reply packet.
[Drawing 8]The figure showing the control sequence of particular node AP.
[Drawing 9]The figure showing the control sequence in the nodes WR1-WR7.
[Drawing 10]The figure showing the example of composition of a route maintaining packet.
[Drawing 11]The figure showing the example of composition of a course maintenance reply packet.
[Drawing 12]The figure showing the course control table of the nodes WR1-WR7 in WR initiative.
[Drawing 13]The figure showing the control sequence in the nodes WR1-WR7.
[Drawing 14]The figure showing the control sequence in the nodes WR1-WR7.
[Description of Notations]
AP Specific wireless node (particular node)
WR wireless node (node)

[Translation done.]

DRAWINGS

[Drawing 1]

無線ネットワークの構成例

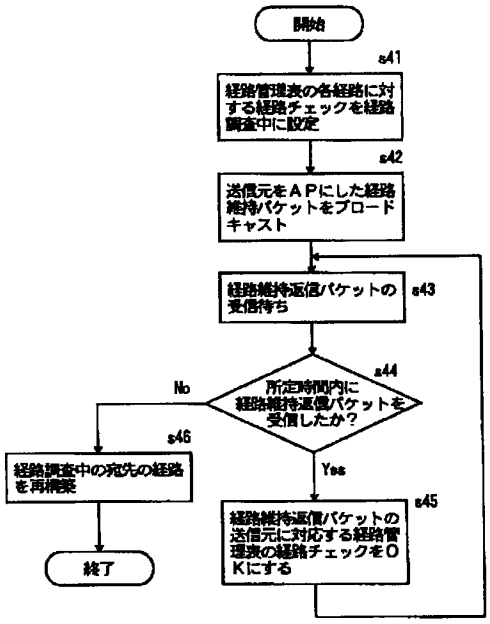


[Drawing 7]

経路維持返信パケットの構成例

[Drawing 8]

特定ノードＡＰの制御シーケンス



[Drawing 10]
経路維持パケットの構成例

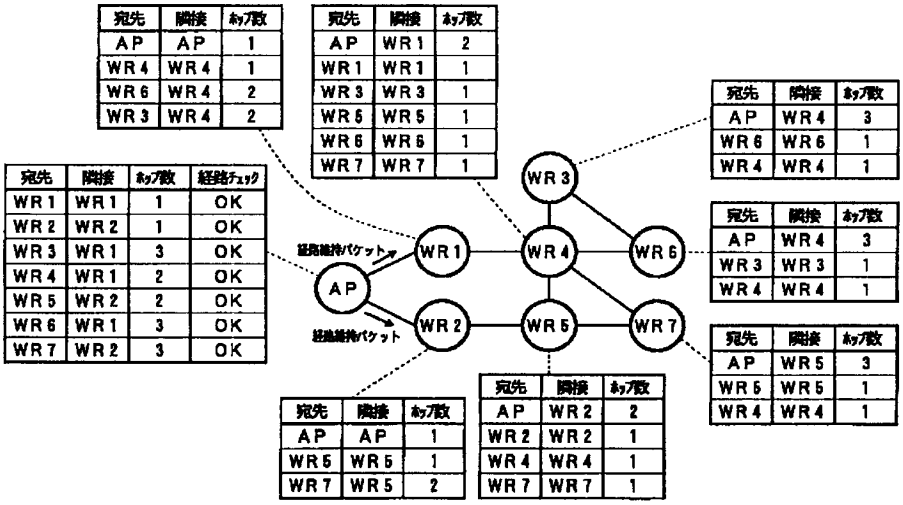
パケット種別：経路維持
宛先：ブロードキャスト
隣接：ブロードキャスト
ホップ数：3
送信元：ＡＰ
発信元：ＡＰ

[Drawing 11]
経路維持返信パケットの構成例

パケット種別：経路維持返信
宛先：ＡＰ
隣接：ＡＰ
ホップ数：1
送信元：ＷＲ１
発信元：ＷＲ１

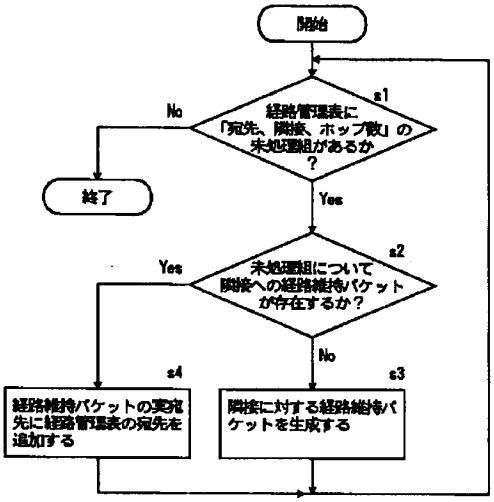
[Drawing 2]

ＡＰ主導の場合の特定ノードＡＰの経路管理表



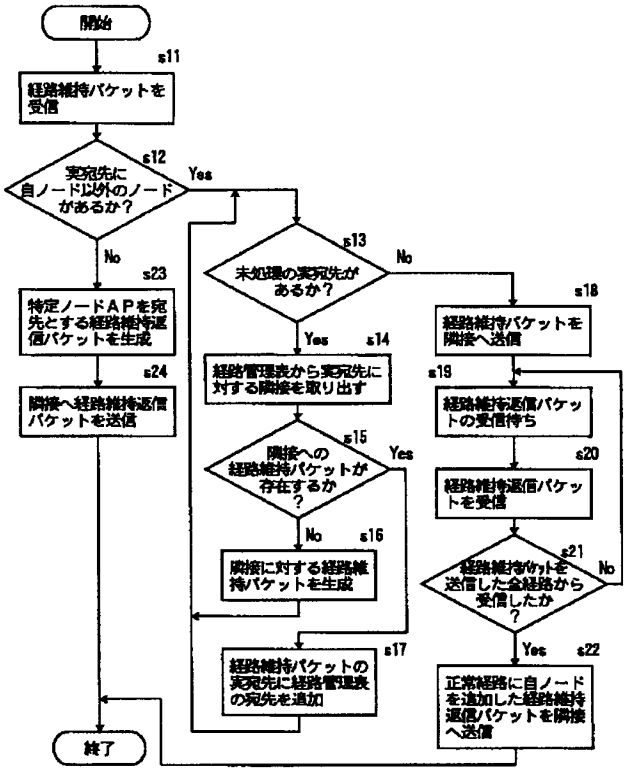
[Drawing 3]

特定ノードＡＰにおける経路維持パケット送信時の制御シーケンス



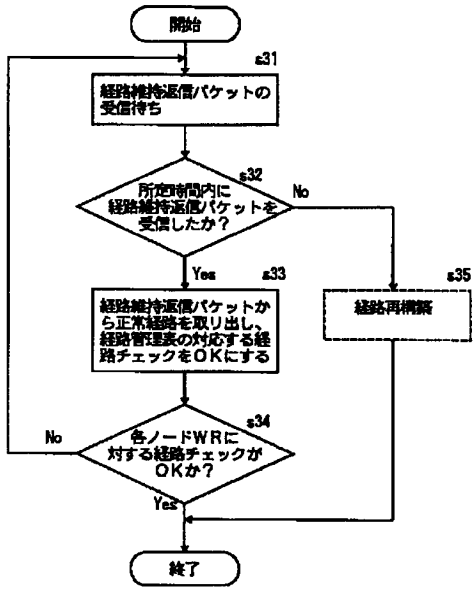
[Drawing 4]

ノードＷＲ１～ＷＲ７における制御シーケンス



[Drawing 5]

特定ノードＡＰにおける経路維持返信パケット受信時の制御シーケンス



[Drawing 6]

経路維持パケットの構成例

(1) [WR1, WR1, 1]

パケット種別：経路維持
宛先：WR1
隣接：WR1
ホップ数：1
送信元：AP
発信元：AP
実宛先：WR1

(2) [WR3, WR1, 3]

パケット種別：経路維持
宛先：WR1
隣接：WR1
ホップ数：1
送信元：AP
発信元：AP
実宛先：WR1
実宛先：WR3

(3) [WR4, WR1, 2]

パケット種別：経路維持
宛先：WR1
隣接：WR1
ホップ数：1
送信元：AP
発信元：AP
実宛先：WR1
実宛先：WR3
実宛先：WR4

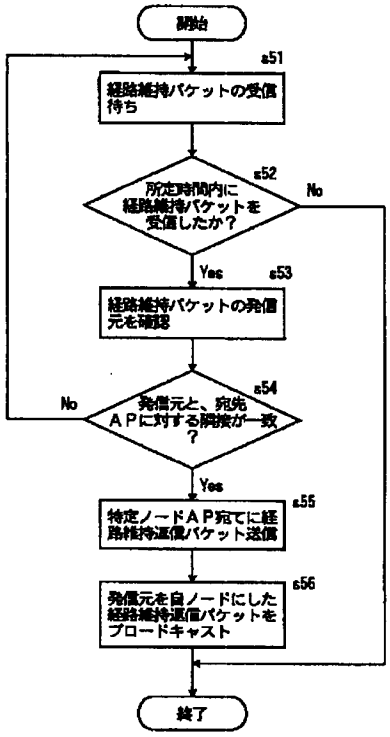
(4) WR1方向

パケット種別：経路維持
宛先：WR1
隣接：WR1
ホップ数：1
送信元：AP
発信元：AP
実宛先：WR1
実宛先：WR3
実宛先：WR4
実宛先：WR6

(3) WR2方向

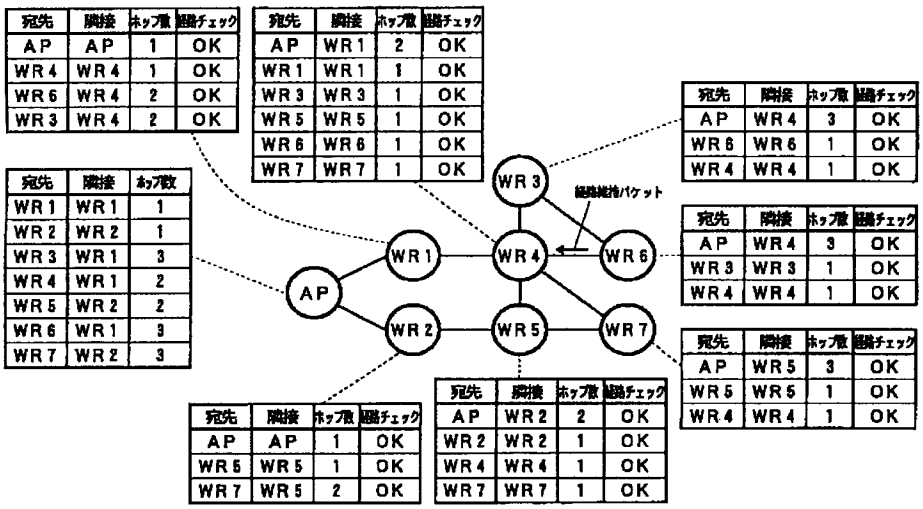
パケット種別：経路維持
宛先：WR2
隣接：WR2
ホップ数：1
送信元：AP
発信元：AP
実宛先：WR2
実宛先：WR5
実宛先：WR7

[Drawing 9]
ノードWR1～WR7における制御シーケンス



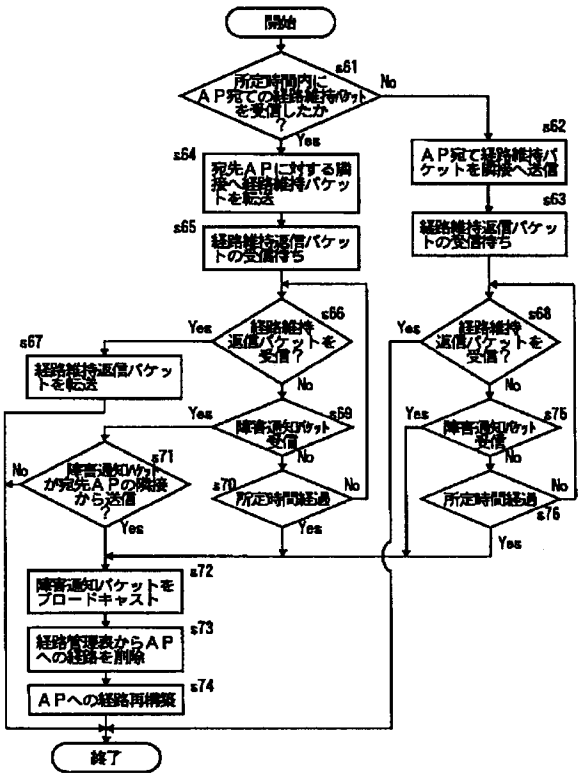
[Drawing 12]

WR主導の場合のノードWR１～WR７の経路管理表



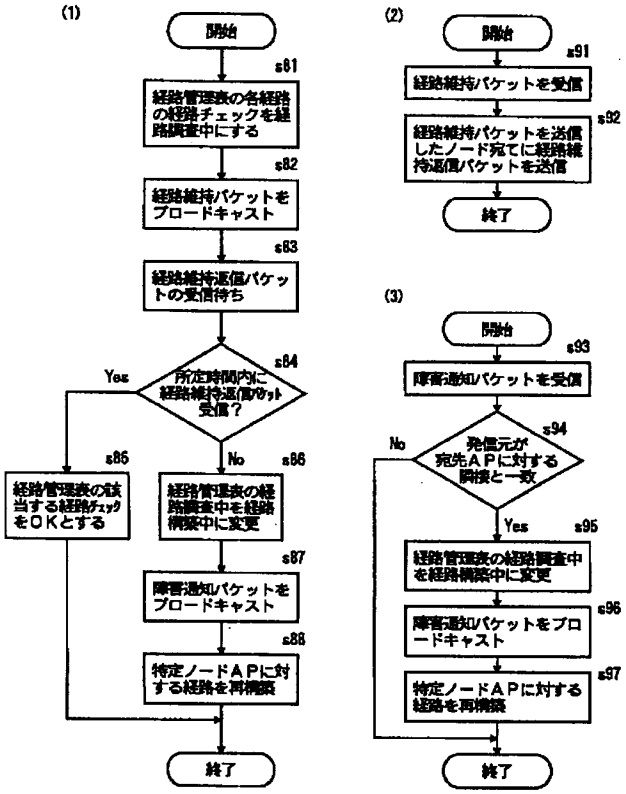
[Drawing 13]

ノードWR１～WR７の制御シーケンス



[Drawing 14]

ノードＷＲ１～ＷＲ７の制御シーケンス



[Translation done.]

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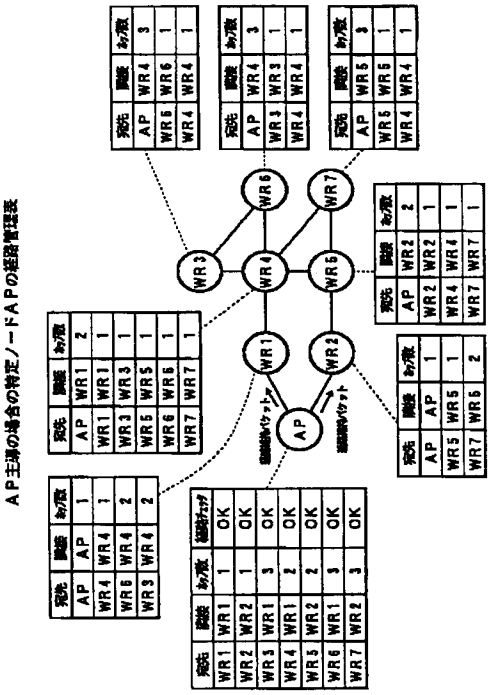
最終頁に続く

(54)【発明の名称】　無線ネットワークにおける経路維持方法、経路維持システムおよび無線ノード装置

(57)【要約】
【課題】　各ノードが特定のノードに頻繁にアクセスし、他のノード間のアクセスが少ない無線ネットワークにおいて、特定のノードとの経路維持に対しては遅延を小さくし、無駄な経路構築処理、経路維持のための処理、これらの処理に伴う無線帯域の無駄を省く。
【解決手段】　特定無線ノードが各無線ノードに対して、または各無線ノードが特定無線ノードに対して経路維持パケットを送信し、経路維持パケットを受信したノードが経路維持返信パケットを送信し、経路維持パケットの送信ノードが経路維持返信パケットの受信確認により、特定無線ノードと各無線ノードとの間の経路を維持する。



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【特許請求の範囲】

【請求項１】　無線インタフェースを介してパケットの送受信を行う無線ノードと、外部のネットワークとのゲートウェイになる特定無線ノードとにより構成される無線ネットワークにおいて、

前記特定無線ノードは、宛先ノード（以下「宛先」という）、宛先ノードにパケットを届けるために転送する隣接ノード（以下「隣接」という）、パケットが宛先ノードに届くまでに必要な経路のメトリック（以下「ホップ数」という）、各無線ノードが所定時間内にパケットを受信したか否かを表す値（以下「経路チェック」という）を記した経路管理表を保持し、「隣接」を同一とする「宛先」すべてを記載した経路維持パケットを生成し、この経路維持パケットを「隣接」に該当する無線ノードへユニキャストし、前記経路維持パケットを受信した無線ノードが送信した経路維持返信パケットを受信して各経路を維持していることを確認し、

前記無線ノードは、「宛先」、「隣接」、「ホップ数」を記した経路管理表を保持し、前記経路維持パケットを受信したときに、この経路維持パケットに記述された全ての「宛先」を取り出し、その「宛先」に対して前記経路管理表の「隣接」を同一とする全ての「宛先」を記載した経路維持パケットを生成し、この経路維持パケットを前記「隣接」に該当する無線ノードへユニキャスト中継し、前記経路維持パケットを中継する必要がない場合または前記経路維持パケットを中継して所定時間経過した場合に、前記特定無線ノードへの経路維持返信パケットを生成してユニキャスト送信し、前記経路維持返信パケットを受信したときはその経路維持返信パケットに自ノードで経路維持パケットを受信したことを示す情報を付加してユニキャスト中継し、

前記無線ノードと前記特定無線ノードとの間でパケットが到達することを常時確認することを特徴とする無線ネットワークにおける経路維持方法。

【請求項２】　無線インタフェースを介してパケットの送受信を行う無線ノードと、外部のネットワークとのゲートウェイになる特定無線ノードとにより構成される無線ネットワークにおいて、

前記特定無線ノードは、宛先ノード（以下「宛先」という）、宛先ノードにパケットを届けるために転送する隣接ノード（以下「隣接」という）、パケットが宛先ノードに届くまでに必要な経路のメトリック（以下「ホップ数」という）、各無線ノードが所定時間内にパケットを受信したか否かを表す値（以下「経路チェック」という）を記した経路管理表を保持し、経路維持パケットを生成し、この経路維持パケットを無線リンクで直接通信可能な範囲にある隣接する無線ノードへブロードキャストし、前記経路維持パケットを受信した無線ノードから送信された経路維持返信パケットを受信して各経路を維持していることを確認し、

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前記無線ノードは、「宛先」、「隣接」、「ホップ数」を記した経路管理表を保持し、前記経路維持パケットを受信したときに、その発信元を確認して前記特定無線ノードからの初めての経路維持パケットである場合には、前記特定無線ノードへの経路維持返信パケットを生成してユニキャスト送信し、

前記無線ノードと前記特定無線ノードとの間でパケットが到達することを常時確認することを特徴とする無線ネットワークにおける経路維持方法。

【請求項３】　無線インタフェースを介してパケットの送受信を行う無線ノードと、外部のネットワークとのゲートウェイになる特定無線ノードとにより構成される無線ネットワークにおいて、

前記無線ノードは、宛先ノード（以下「宛先」という）、宛先ノードにパケットを届けるために転送する隣接ノード（以下「隣接」という）、パケットが宛先ノードに届くまでに必要な経路のメトリック（以下「ホップ数」という）、各無線ノードが所定時間内にパケットを受信したか否かを表す値（以下「経路チェック」という）を記した経路管理表を保持し、所定の時刻に経路維持パケットを生成して前記特定無線ノードへユニキャストし、前記経路維持パケットを受信したときに自ノードを一意に識別できる情報を経路維持パケットに付加して前記特定無線ノードへ中継し、前記特定無線ノードが送信した経路維持返信パケットを受信すると前記特定無線ノードとの経路を前記経路管理表に記録し、この経路維持返信パケットが自ノード宛ての場合はそれを廃棄し、他の無線ノード宛ての場合はそれを中継し、

前記特定無線ノードは、「宛先」、「隣接」、「ホップ数」を記した経路管理表を保持し、前記経路維持パケットを受信したときに、この経路維持パケットから通過した無線ノードの情報を取り出し、その経路情報を前記経路管理表に記録し、前記経路維持パケットから送信元を取り出してその送信元へ経路維持返信パケットをユニキャストし、

前記無線ノードと前記特定無線ノードとの間でパケットが到達することを常時確認することを特徴とする無線ネットワークにおける経路維持方法。

【請求項４】　無線インタフェースを介してパケットの送受信を行う無線ノードと、外部のネットワークとのゲートウェイになる特定無線ノードとにより構成される無線ネットワークにおいて、

前記無線ノードは、宛先ノード（以下「宛先」という）、宛先ノードにパケットを届けるために転送する隣接ノード（以下「隣接」という）、パケットが宛先ノードに届くまでに必要な経路のメトリック（以下「ホップ数」という）、各無線ノードが所定時間内にパケットを受信したか否かを表す値（以下「経路チェック」という）を記した経路管理表を保持し、所定の時刻に経路維持パケットを生成して隣接する無線ノードへブロードキ

ャストし、前記経路維持バケットを受信したときにその送信元へ経路維持返信バケットをユニキャストし、隣接する無線ノードから経路維持返信バケットを受信できないときは、前記経路管理表からその隣接する無線ノードに対応する情報を削除して経路の再構築を行うことを特徴とする無線ネットワークにおける経路維持方法。

【請求項５】　請求項１または請求項２に記載の無線ネットワークにおける経路維持方法において、

前記特定無線ノードは、前記経路管理表に記された「経路チェック」に用いるバケットの受信に要する所定時間について、前記無線ノードからその所定時間内にバケットが送られてこない場合には、前記無線ノードとの間の経路を再構築することを特徴とする無線ネットワークにおける経路維持方法。

【請求項６】　請求項３または請求項４に記載の無線ネットワークにおける経路維持方法において、

前記無線ノードは、他の無線ノードに前記経路管理表に基づいた経路でバケットを送信してから所定時間経過しても返信バケットがない場合に、前記経路管理表に記された「隣接」のうち、返信バケットのない経路の「隣接」と同一の経路を削除し、障害通知バケットを無線リンクで直接通信可能な範囲にある隣接する無線ノードへブロードキャストし、前記無線ノードとの間の経路を再構築することを特徴とする無線ネットワークにおける経路維持方法。

【請求項７】　無線インタフェースを介してバケットの送受信を行う無線ノードと、外部のネットワークとのゲートウェイになる特定無線ノードとにより構成される無線ネットワークにおいて、

前記特定無線ノードは、宛先ノード（以下「宛先」という）、宛先ノードにバケットを届けるために転送する隣接ノード（以下「隣接」という）、バケットが宛先ノードに届くまでに必要な経路のメトリック（以下「ホップ数」という）、各無線ノードが所定時間内にバケットを受信したか否かを表す値（以下「経路チェック」という）を記した経路管理表を保持し、「隣接」を同一とする「宛先」すべてを記載した経路維持バケットを生成する手段と、この経路維持バケットを「隣接」に該当する無線ノードへユニキャストする手段と、前記経路維持バケットを受信した無線ノードが送信した経路維持返信バケットを受信して各経路を維持していることを確認する手段とを備え、

前記無線ノードは、「宛先」、「隣接」、「ホップ数」を記した経路管理表を保持し、前記経路維持バケットを受信したときに、この経路維持バケットに記述された全ての「宛先」を取り出し、その「宛先」に対して前記経路管理表の「隣接」を同一とする全ての「宛先」を記載した経路維持バケットを生成する手段と、この経路維持バケットを前記「隣接」に該当する無線ノードへユニキャスト中継する手段と、前記経路維持バケットを中継する必要がない場合または前記経路維持バケットを中継して所定時間経過した場合に、前記特定無線ノードへの経路維持返信バケットを生成してユニキャスト送信する手段と、前記経路維持返信バケットを受信したときはその経路維持返信バケットに自ノードで経路維持バケットを受信したことを示す情報を付加してユニキャスト中継する手段とを備え、

前記無線ノードと前記特定無線ノードとの間でバケットが到達することを常時確認することを特徴とする無線ネットワークにおける経路維持システム。

【請求項８】　無線インタフェースを介してバケットの送受信を行う無線ノードと、外部のネットワークとのゲートウェイになる特定無線ノードとにより構成される無線ネットワークにおいて、

前記特定無線ノードは、宛先ノード（以下「宛先」という）、宛先ノードにバケットを届けるために転送する隣接ノード（以下「隣接」という）、バケットが宛先ノードに届くまでに必要な経路のメトリック（以下「ホップ数」という）、各無線ノードが所定時間内にバケットを受信したか否かを表す値（以下「経路チェック」という）を記した経路管理表を保持し、経路維持バケットを生成する手段と、この経路維持バケットを無線リンクで直接通信可能な範囲にある隣接する無線ノードへブロードキャストする手段と、前記経路維持バケットを受信した無線ノードから送信された経路維持返信バケットを受信して各経路を維持していることを確認する手段とを備え、

前記無線ノードは、「宛先」、「隣接」、「ホップ数」を記した経路管理表を保持し、前記経路維持バケットを受信したときに、その発信元を確認して前記特定無線ノードからの初めての経路維持バケットである場合には、前記特定無線ノードへの経路維持返信バケットを生成してユニキャスト送信する手段を備え、

前記無線ノードと前記特定無線ノードとの間でバケットが到達することを常時確認することを特徴とする無線ネットワークにおける経路維持システム。

【請求項９】　無線インタフェースを介してバケットの送受信を行う無線ノードと、外部のネットワークとのゲートウェイになる特定無線ノードとにより構成される無線ネットワークにおいて、

前記無線ノードは、宛先ノード（以下「宛先」という）、宛先ノードにバケットを届けるために転送する隣接ノード（以下「隣接」という）、バケットが宛先ノードに届くまでに必要な経路のメトリック（以下「ホップ数」という）、各無線ノードが所定時間内にバケットを受信したか否かを表す値（以下「経路チェック」という）を記した経路管理表を保持し、所定の時刻に経路維持バケットを生成して前記特定無線ノードへユニキャストする手段と、前記経路維持バケットを受信したときに自ノードを一意に識別できる情報を経路維持バケットに

付加して前記特定無線ノードへ中継する手段と、前記特定無線ノードが送信した経路維持返信バケットを受信すると前記特定無線ノードとの経路を前記経路管理表に記録する手段と、この経路維持返信バケットが自ノード宛ての場合はそれを廃棄し、他の無線ノード宛ての場合はそれを中継する手段とを備え、
前記特定無線ノードは、「宛先」、「隣接」、「ホップ数」を記した経路管理表を保持し、前記経路維持バケットを受信したときに、この経路維持バケットから通過した無線ノードの情報を取り出し、その経路情報を前記経路管理表に記録する手段と、前記経路維持バケットから送信元を取り出してその送信元へ経路維持返信バケットをユニキャストする手段とを備え、
前記無線ノードと前記特定無線ノードとの間でバケットが到達することを常時確認することを特徴とする無線ネットワークにおける経路維持システム。
【請求項１０】　無線インタフェースを介してバケットの送受信を行う無線ノードと、外部のネットワークとのゲートウェイになる特定無線ノードとにより構成される無線ネットワークにおいて、
前記無線ノードは、宛先ノード（以下「宛先」という）、宛先ノードにバケットを届けるために転送する隣接ノード（以下「隣接」という）、バケットが宛先ノードに届くまでに必要な経路のメトリック（以下「ホップ数」という）、各無線ノードが所定時間内にバケットを受信したか否かを表す値（以下「経路チェック」という）を記した経路管理表を保持し、所定の時刻に経路維持バケットを生成して隣接する無線ノードへブロードキャストする手段と、前記経路維持バケットを受信したときにその送信元へ経路維持返信バケットをユニキャストする手段と、隣接する無線ノードから経路維持返信バケットを受信できないときは、前記経路管理表からその隣接する無線ノードに対応する情報を削除して経路の再構築を行う手段とを備えたことを特徴とする無線ネットワークにおける経路維持システム。
【請求項１１】　請求項７または請求項８に記載の無線ネットワークにおける経路維持システムにおいて、
前記特定無線ノードは、前記経路管理表に記された「経路チェック」に用いるバケットの受信に要する所定時間について、前記無線ノードからその所定時間内にバケットが送られてこないときに、前記無線ノードとの間の経路を再構築する手段を備えたことを特徴とする無線ネットワークにおける経路維持システム。
【請求項１２】　請求項１０または請求項９に記載の無線ネットワークにおける経路維持システムにおいて、
前記無線ノードは、他の無線ノードに前記経路管理表に基づいた経路でバケットを送信してから所定時間経過しても返信バケットがない場合に、前記経路管理表に記された「隣接」のうち、返信バケットのない経路の「隣接」と同一の経路を削除する手段と、障害通知バケットを無線リンクで直接通信可能な範囲にある隣接する無線ノードへブロードキャストする手段と、前記無線ノードとの間の経路を再構築する手段とを備えたことを特徴とする無線ネットワークにおける経路維持システム。
【請求項１３】　無線インタフェースを介してバケットの送受信を行う無線ノードと、外部のネットワークとのゲートウェイになる特定無線ノードとにより構成される無線ネットワークにおいて、
請求項７～１１のいずれかに記載の無線ネットワークにおける経路維持システムを構成する特定無線ノードの各手段を備えたことを特徴とする無線ノード装置。
【請求項１４】　無線インタフェースを介してバケットの送受信を行う無線ノードと、外部のネットワークとのゲートウェイになる特定無線ノードとにより構成される無線ネットワークにおいて、
請求項７～１０，１２のいずれかに記載の無線ネットワークにおける経路維持システムを構成する無線ノードの各手段を備えたことを特徴とする無線ノード装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、各無線ノードが特定の無線ノードに頻繁にアクセスし、他の無線ノード間のアクセスが少ない無線ネットワークにおいて、特定の無線ノードとの経路維持を行う経路維持方法、経路維持システムおよび無線ノード装置に関する。
【０００２】
【従来の技術】無線ネットワークにおける無線ノード（以下「ノード」という）間でのバケット転送に関する従来の経路管理は、経路を常時構築しておくテーブル駆動方式と、通信の必要が生じた際に転送経路を構築するオンデマンド方式と、テーブル駆動方式とオンデマンド方式を組み合わせたハイブリッド方式とがある。
【０００３】テーブル駆動方式は、各ノードが定期的あるいはトポロジーの変化を検出したときに、経路情報を各ノードに通知し、各ノードがその情報に基づいて経路を再構築して経路を維持するので、通信が生じたときにすぐにバケットの送信を開始することができる。しかし、特定のノードが多くのノードから頻繁にアクセスされる通信形態では、不要な経路構築のための処理や通信が生じる。
【０００４】一方、オンデマンド方式は、例えば文献（Charles E. Perkins, "Ad Hoc On-Demand Distance Vector Routing", in Proceedings of the 2nd IEEE Workshopon Mobile Computing Systems and Applications, pp.90-100, 1999 ）で提案されているＡＯＤＶ（Ad Hoc On-Demand Distance Vector Routing）では、通信が生じたときにネットワーク全体に経路探索バケットをブロードキャストし、宛先ノードなどがその返信を返すことにより経路構築が可能になる。したがって、特定の経路に対して経路維持のための処理は不要となるが、通信

が生じてから最初のデータパケットが送信されるまでの遅延が避けられない。また、無線リンクで直接通信可能な範囲にある隣接ノードを認識できなければ通信ができないので、経路維持パケットを直接通信可能な範囲にある隣接ノードにブロードキャストする。この経路維持パケットを受信したノードは、経路維持パケットを受信することにより隣接ノード（送信ノード）を認識するが、一定時間この経路維持パケットが受信されなければ、障害等によるトポロジーの変化が起きたことを認識する。このため、トポロジーの変化が起きたことを認識するまでに、この一定時間以上の時間が必要になる。

【０００５】また、ハイブリッド方式は、例えば文献（Zygmunt J. Hass,"A New Routing Protocol for the Reconfigurable Wireless Networks", in IEEE ICUPC '97,pp.652-566, 1997)で提案されているＺＲＰ（Zone Routing Protocol)では、ゾーン半径という概念を導入し、各ノードはゾーン半径内のノードへの経路はテーブル駆動方式で管理し、ゾーン半径外のノードへの経路はオンデマンド方式で構築することとしている。このため、特定のノードがゾーン半径内になるようにゾーン半径を設定すると、テーブル駆動方式と同様に、特定のノードが多くのノードから頻繁にアクセスされる通信形態では、不要な経路構築のための処理や通信が生じる。一方、特定のノードがゾーン半径外になるようにゾーン半径を設定すると、オンデマンド方式と同様に、特定のノードが多くのノードから頻繁にアクセスされる通信形態では常に遅延が生じることになる。

【０００６】

【発明が解決しようとする課題】ところで、外部のネットワークとのゲートウェイとなる特定のノードは、多くのノードから頻繁にアクセスされることになるので、このような通信形態では上記のような問題が起こる。

【０００７】すなわち、従来のテーブル駆動方式では、すべてのノードに対する経路情報をもつ必要があり、障害等によりトポロジーの変化を検出すると、検出したノードは経路の再構築のために全ノードに通知し、各ノードはこの通知を元に経路を再構築する必要がある。このように、すべてのノードの経路を維持することは、「特定のノード」へのアクセス頻度が高いシステムでは、「特定のノード」以外の経路構築処理、経路維持のための処理、これらの処理に伴う無線帯域が無駄になる。

【０００８】また、従来のオンデマンド方式は、経路維持を行う必要がない代わりに、特定のノードが多くのノードから頻繁にアクセスされる通信形態では常に遅延が生じることになる。特に、各ノードは、経路維持パケットを隣接ノードにのみ送信するだけで、隣接ノードから経路維持パケットの返信を受けることはなく、隣接ノードが経路維持パケットを受信しているか否かを確認できなかった。したがって、隣接ノードから受信できるが隣接ノードへ送信できない場合には対処できず、別の手段でトポロジーの変化を認識する必要があったので、トポロジーの変化を認識して経路を再構築するまでに時間がかかり、遅延が大きくなっていた。

【０００９】また、従来のハイブリッド方式は、ノードからの距離によってテーブル駆動方式とオンデマンド方式とを切り替えるので、従来のテーブル駆動方式およびオンデマンド方式の各問題点をそのまま有している。

【００１０】本発明は、各ノードが特定のノードに頻繁にアクセスし、他のノード間のアクセスが少ない無線ネットワークにおいて、特定のノードとの経路維持に対しては遅延を小さくし、無駄な経路構築処理、経路維持のための処理、これらの処理に伴う無線帯域の無駄を省くことができる経路維持方法、経路維持システムおよび無線ノード装置を提供することを目的とする。

【００１１】

【課題を解決するための手段】本発明の無線ネットワークにおける経路維持方法、経路維持システムおよび無線ノード装置は、特定無線ノードが各無線ノードに対して、または各無線ノードが特定無線ノードに対して経路維持パケットを送信し、経路維持パケットを受信したノードが経路維持返信パケットを送信し、経路維持パケットの送信ノードが経路維持返信パケットの受信確認により、特定無線ノードと各無線ノードとの間の経路を維持するものである。

【００１２】請求項１，７，１３，１４に記載の発明では、特定無線ノードは、「宛先」、「隣接」、「ホップ数」、「経路チェック」を記した経路管理表を保持し、「隣接」を同一とする「宛先」すべてを記載した経路維持パケットを生成し、この経路維持パケットを「隣接」に該当する無線ノードへユニキャストし、経路維持パケットを受信した無線ノードが送信した経路維持返信パケットを受信して各経路を維持していることを確認する。

【００１３】無線ノードは、「宛先」、「隣接」、「ホップ数」を記した経路管理表を保持し、経路維持パケットを受信したときに、この経路維持パケットに記述された全ての「宛先」を取り出し、その「宛先」に対して経路管理表の「隣接」を同一とする全ての「宛先」を記載した経路維持パケットを生成し、この経路維持パケットを「隣接」に該当する無線ノードへユニキャスト中継し、経路維持パケットを中継する必要がない場合または経路維持パケットを中継して所定時間経過した場合に、特定無線ノードへの経路維持返信パケットを生成してユニキャスト送信し、経路維持返信パケットを受信したときはその経路維持返信パケットに自ノードで経路維持パケットを受信したことを示す情報を付加してユニキャスト中継する。

【００１４】請求項２，８，１３，１４に記載の発明では、特定無線ノードは、「宛先」、「隣接」、「ホップ数」、「経路チェック」を記した経路管理表を保持し、経路維持パケットを生成し、この経路維持パケットを無

線リンクで直接通信可能な範囲にある隣接する無線ノードへブロードキャストし、経路維持バケットを受信した無線ノードから送信された経路維持返信バケットを受信して各経路を維持していることを確認する。

【００１５】無線ノードは、「宛先」、「隣接」、「ホップ数」を記した経路管理表を保持し、経路維持バケットを受信したときに、その発信元を確認して特定無線ノードからの初めての経路維持バケットである場合には、特定無線ノードへの経路維持返信バケットを生成してユニキャスト送信する。

【００１６】請求項３，９，１３，１４に記載の発明では、無線ノードは、「宛先」、「隣接」、「ホップ数」、「経路チェック」を記した経路管理表を保持し、所定の時刻に経路維持バケットを生成して特定無線ノードへユニキャストし、経路維持バケットを受信したときに自ノードを一意に識別できる情報を経路維持バケットに付加して特定無線ノードへ中継し、特定無線ノードが送信した経路維持返信バケットを受信すると特定無線ノードとの経路を経路管理表に記録し、この経路維持返信バケットが自ノード宛ての場合はそれを廃棄し、他の無線ノード宛ての場合はそれを中継する。

【００１７】特定無線ノードは、「宛先」、「隣接」、「ホップ数」を記した経路管理表を保持し、経路維持バケットを受信したときに、この経路維持バケットから通過した無線ノードの情報を取り出し、その経路情報を経路管理表に記録し、経路維持バケットから送信元を取り出してその送信元へ経路維持返信バケットをユニキャストする。

【００１８】請求項４，１０，１３，１４に記載の発明では、無線ノードは、「宛先」、「隣接」、「ホップ数」、「経路チェック」を記した経路管理表を保持し、所定の時刻に経路維持バケットを生成して隣接する無線ノードへブロードキャストし、経路維持バケットを受信したときにその送信元へ経路維持返信バケットをユニキャストし、隣接する無線ノードから経路維持返信バケットを受信できないときは、経路管理表からその隣接する無線ノードに対応する情報を削除して経路の再構築を行う。

【００１９】請求項５，１１，１３に記載の発明では、特定無線ノードは、経路管理表に記された「経路チェック」に用いるバケットの受信に要する所定時間について、無線ノードからその所定時間内にバケットが送られてこない場合には、無線ノードとの間の経路を再構築する。

【００２０】請求項６，１２，１４に記載の発明では、無線ノードは、他の無線ノードに経路管理表に基づいた経路でバケットを送信してから所定時間経過しても返信バケットがない場合に、経路管理表に記された「隣接」のうち、返信バケットのない経路の「隣接」と同一の経路を削除し、障害通知バケットを無線リンクで直接通信可能な範囲にある隣接する無線ノードへブロードキャストし、無線ノードとの間の経路を再構築する。

【００２１】

【発明の実施の形態】図１は、無線ネットワークの構成例を示す。図において、外部のネットワークとのゲートウェイとなる特定のノードをＡＰ（アクセスポイント）とし、特定ノードＡＰにノードＷＲ１，ＷＲ２が無線リンクを介して接続され、さらにノードＷＲ１とノードＷＲ４が接続され、ノードＷＲ４とノードＷＲ３、ＷＲ５、ＷＲ６およびＷＲ７が接続され、ノードＷＲ２とノードＷＲ５が接続され、さらにノードＷＲ５とＷＲ７が接続され、ノードＷＲ３とノードＷＲ６が接続される。

【００２２】各ノードの経路管理表は、「宛先（宛先ノード）」、「隣接（宛先ノードにバケットを届けるために転送する隣接ノード）」、「ホップ数（バケットが宛先ノードに届くまでに必要な経路のメトリック）」から構成される。例えば、特定ノードＡＰにおいては、宛先ＷＲ１に対して隣接ＷＲ１、ホップ数１となり、宛先ＷＲ３に対して隣接ＷＲ１、ホップ数２となる。また、各ノードＷＲ１～７の経路管理表には、特定ノードＡＰを宛先とした場合の隣接およびホップ数が設定されている。

【００２３】本発明は、特定ノードＡＰが各ノードＷＲ１～ＷＲ７に対して、または各ノードＷＲ１～ＷＲ７が特定ノードＡＰに対して経路維持バケットを送信し、経路維持バケットを受信したノードが経路維持返信バケットを送信し、経路維持バケットの送信ノードが経路維持返信バケットの受信確認により、特定ノードＡＰと各ノードＷＲ１～ＷＲ７との間の経路を維持するものである。以下、特定ノードＡＰから各ノードＷＲ１～ＷＲ７に対して経路維持バケットを送信するＡＰ主導の実施形態と、各ノードＷＲ１～ＷＲ７が特定ノードＡＰに対して経路維持バケットを送信するＷＲ主導の実施形態について説明する。

【００２４】＜ＡＰ主導の実施形態：請求項１，２，５，７，８，１１＞図２は、ＡＰ主導の場合の特定ノードＡＰの経路管理表を示す。なお、無線ネットワークの構成およびノードＷＲ１～ＷＲ７の経路管理表は、図１に示すものと同じである。

【００２５】特定ノードＡＰの経路管理表は、「宛先」、「隣接」、「ホップ数」の他に「経路チェック」の欄が設けられる。「経路チェック」は、経路維持返信バケットの受信確認によって、各ノードが所定時間内に経路維持バケットを受信したか否かを表すものである。

【００２６】（ＡＰ主導の第１の制御シーケンス：請求項１，７）ＡＰ主導の第１の制御シーケンスを図３～図７を参照して説明する。図３は、特定ノードＡＰにおける経路維持バケット送信時の制御シーケンスを示す。図４は、ノードＷＲ１～ＷＲ７における制御シーケンスを示す。図５は、特定ノードＡＰにおける経路維持返信バ

ケット受信時の制御シーケンスを示す。図６は、経路維持バケットの構成例を示す。図７は、経路維持返信バケットの構成例を示す。

【００２７】（特定ノードＡＰにおける経路維持バケット送信時の制御シーケンス）図２，３において、特定ノードＡＰは、経路管理表に「宛先」、「隣接」、「ホップ数」からなる未処理の組があるか否かを調べ、未処理の組があれば、経路維持バケットを生成する。経路維持バケットは、図６に示すように、バケット種別、宛先、隣接、ホップ数、送信元、発信元、実宛先から構成される。なお、実宛先とは、経路維持バケットを受信すべきノードを意味する。

【００２８】ここで、特定ノードＡＰの経路管理表の「宛先」、「隣接」、「ホップ数」の組を［宛先、隣接、ホップ数］と記述する。まず、図２に示すように［ＷＲ１，ＷＲ１，１］の組があり、隣接ノードがＷＲ１であることが分かる（s1）。ここでは隣接ＷＲ１への経路維持バケットが存在しない（初めての経路維持バケットである）ので（s2）、図６(1)に示すような経路維持バケット（バケット種別：経路維持、宛先：ＷＲ１、隣接：ＷＲ１、ホップ数：１、送信元：ＡＰ、発信元：ＡＰ、実宛先：ＷＲ１）を生成する（s3）。次に、［ＷＲ２，ＷＲ２，１］については、同様に隣接ＷＲ２への経路維持バケット（バケット種別：経路維持、宛先：ＷＲ２、隣接：ＷＲ２、ホップ数：１、送信元：ＡＰ、発信元：ＡＰ、実宛先：ＷＲ２）を生成する（s3）。

【００２９】次に、［ＷＲ３，ＷＲ１，３］については、すでに隣接ＷＲ１への経路維持バケットが存在するので（s2）、この経路維持バケットの実宛先にＷＲ３を追加する（s4、図６(2)）。［ＷＲ４，ＷＲ１，２］については、すでに隣接ＷＲ１への経路維持バケットが存在するので（s2）、この経路維持バケットの実宛先にＷＲ４を追加する（s4、図６(3)）。以下同様に、［ＷＲ５，ＷＲ２，２］、［ＷＲ６，ＷＲ１，３］、［ＷＲ７，ＷＲ２，３］に対しても、それぞれ実宛先の追加による経路維持バケットを生成する。

【００３０】以上により、経路維持バケットはＷＲ１方向とＷＲ２方向の２種類が生成される。ＷＲ１方向の経路維持バケットは、バケット種別：経路維持、宛先：ＷＲ１、隣接：ＷＲ１、ホップ数：１、送信元：ＡＰ、発信元：ＡＰ、実宛先：ＷＲ１，ＷＲ３，ＷＲ４，ＷＲ６である（図６(4)）。一方、ＷＲ２方向の経路維持バケットは、バケット種別：経路維持、宛先：ＷＲ２、隣接：ＷＲ２、ホップ数：１、送信元：ＡＰ、発信元：ＡＰ、実宛先：ＷＲ２，ＷＲ５，ＷＲ７である（図６(5)）。そして、各経路の経路チェックを経路調査中にし、２種類の経路維持バケットをノードＷＲ１，ＷＲ２に送信する。

【００３１】（ノードＷＲ１～ＷＲ７における制御シーケンス）図２，４において、ノードＷＲ１が経路維持バケットを受信すると（s11）、実宛先に自ノード以外のノードがあるか否かを調べる（s12）。ここでは、実宛先に自ノード以外のノードＷＲ３，ＷＲ４，ＷＲ６があるので、ノードＷＲ１の経路管理表に従って経路維持バケットを生成する(s13～s17)。実宛先ＷＲ４に対しては、経路管理表の［ＷＲ４，ＷＲ４，１］から隣接がＷＲ４であることが分かり、隣接ＷＲ４への経路維持バケットが存在しないので、隣接ＷＲ４への経路維持バケット（バケット種別：経路維持、宛先：ＷＲ４、隣接：ＷＲ４、ホップ数：１、実宛先：ＷＲ４）を生成する。［ＷＲ６，ＷＲ４，２］については、すでに隣接ＷＲ４への経路維持バケットが存在するので、この経路維持バケットの実宛先にＷＲ６を追加する。［ＷＲ３，ＷＲ４，２］についても同様である。これにより、ノードＷＲ１は、バケット種別：経路維持、宛先：ＷＲ４、隣接：ＷＲ４、ホップ数：１、実宛先：ＷＲ３，ＷＲ４，ＷＲ６となる経路維持バケットをノードＷＲ４に送信し（s18)、経路維持返信バケットの受信待ちとなる（s19)。

【００３２】ノードＷＲ４は、ノードＷＲ１からの経路維持バケットを受信すると、ノードＷＲ１と同様に処理する。すなわち、ノードＷＲ３に対して、バケット種別：経路維持、宛先：ＷＲ３、隣接：ＷＲ３、ホップ数：１、実宛先：ＷＲ３となる経路維持バケットを送信する（s18)。さらに、ノードＷＲ６に対して、バケット種別：経路維持、宛先：ＷＲ６、隣接：ＷＲ６、ホップ数：１、実宛先：ＷＲ６となる経路維持バケットを送信する（s18)。そして、経路維持返信バケットの受信待ちとなる（s19)。

【００３３】ノードＷＲ３は、ノードＷＲ４からの経路維持バケットを受信すると、実宛先に自ノード以外のノードが存在しないので（s12)、送信元である特定ノードＡＰに対する経路維持返信バケットを生成し、ノードＷＲ４に返信する（s23,s24)。経路維持返信バケットは、図７に示すように、バケット種別、宛先、隣接、ホップ数、送信元、発信元、正常経路から構成される。この経路維持返信バケットは、バケット種別：経路維持返信、宛先：ＡＰ、隣接：ＷＲ４、ホップ数：３、送信元：ＷＲ３、発信元：ＷＲ３、正常経路：ＷＲ３に設定される（図７(1))。ノードＷＲ６もノードＷＲ３と同様の処理を行う。

【００３４】ノードＷＲ４は、ｓ19において経路維持返信バケットの受信待ちとなっており、ノードＷＲ３とＷＲ６から経路維持返信バケットを受信すると（s20,s21)、それらの正常経路に自ノードを追加した新たに経路維持返信バケットを生成し、受信した経路維持返信バケットを破棄する。新たな経路維持返信バケットは、バケット種別：経路維持返信、宛先：ＡＰ、隣接：ＷＲ１、ホップ数：２、送信元：ＷＲ４、発信元：ＷＲ４、正常経路：ＷＲ３，ＷＲ４，ＷＲ６に設定され（図７(2))、ノードＷＲ１に送信される（s22)。

【００３５】ノードＷＲ１は、ノードＷＲ４と同様の処理を行う。経路維持返信バケットは、バケット種別：経路維持返信、宛先：ＡＰ、隣接：ＡＰ、ホップ数：１、送信元：ＷＲ１、発信元：ＷＲ１、正常経路：ＷＲ１，ＷＲ３，ＷＲ４，ＷＲ６と設定され（図７(3))、特定ノードＡＰに送信される。

【００３６】ノードＷＲ２，ＷＲ５，ＷＲ７のルートについても同様に、ノードＷＲ２からバケット種別：経路維持返信、宛先：ＡＰ、隣接：ＡＰ、ホップ数：１、送信元：ＷＲ２、発信元：ＷＲ２、正常経路：ＷＲ２，ＷＲ５，ＷＲ７と設定された経路維持返信バケットが特定ノードＡＰに送信される。

【００３７】（特定ノードＡＰにおける経路維持返信バケット受信時の制御シーケンス）図２，５において、特定ノードＡＰは２種類の経路維持バケットをノードＷＲ１，ＷＲ２に送信した後に、経路維持返信バケットの受信待ちになっており（s31)、所定時間内にノードＷＲ１からの経路維持返信バケットを受信すると（s32)、経路維持返信バケットから正常経路ＷＲ１，ＷＲ３，ＷＲ４，ＷＲ６を取り出し、経路管理表の宛先ＷＲ１，ＷＲ３，ＷＲ４，ＷＲ６に対応する各経路チェックを経路調査中からＯＫに変更する（s33)。ノードＷＲ２からの経路維持返信バケットについても同様に処理する（s34)。

【００３８】（ＷＲ５とＷＲ７との間の障害発生時の処理：請求項５，１１）図２において、ノードＷＲ５は、ノードＷＲ２から経路維持バケットを受信し、上述した手順に従ってノードＷＲ７に経路維持バケットを転送し、経路維持返信バケットの受信待ち状態に入る（図４、s19)。ここで、所定時間経過してもノードＷＲ７から経路維持返信バケットが受信されない場合には、ノードＷＲ５は経路維持返信バケットを生成する。この経路維持返信バケットは、バケット種別：経路維持返信、宛先：ＡＰ、隣接：ＷＲ２、ホップ数：２、送信元：ＷＲ５、発信元：ＷＲ５、正常経路：ＷＲ５を設定してノードＷＲ２に送信される。

【００３９】ノードＷＲ２は、受信した経路維持返信バケットのバケット種別：経路維持返信、宛先：ＡＰ、隣接：ＡＰ、ホップ数：１、送信元：ＷＲ２、発信元：ＷＲ２、正常経路：ＷＲ２，ＷＲ５を設定して特定ノードＡＰに送信される。

【００４０】特定ノードＡＰは、受信した経路維持返信バケットから正常経路ＷＲ２，ＷＲ５を取り出し、経路管理表の宛先ＷＲ２，ＷＲ５に対応する各経路チェックを経路調査中からＯＫに変更する。特定ノードＡＰは、経路維持バケットを送信後から所定時間経過すると、経路管理表の各経路チェックを調べ、経路調査中の宛先ＷＲ７の経路に対しては経路の再構築を行う（図５、s35)。

【００４１】（ＡＰ主導の第２の制御シーケンス：請求項２，８）ＡＰ主導の第２の制御シーケンスを図８～図１１を参照して説明する。図８は、特定ノードＡＰの制御シーケンスを示す。図９は、ノードＷＲ１～ＷＲ７における制御シーケンスを示す。図１０は、経路維持バケットの構成例を示す。図１１は、経路維持返信バケットの構成例を示す。

【００４２】経路維持バケットは、図１０に示すように、バケット種別、宛先、隣接、ホップ数、送信元、発信元から構成される。ここでは、バケット種別：経路維持、宛先：ブロードキャスト、隣接：ブロードキャスト、ホップ数：経路管理表のホップ数の最大値（３）、送信元：ＡＰ、発信元：ＡＰに設定される。

【００４３】図２，８において、特定ノードＡＰは、経路管理表の各経路に対する経路チェックを経路調査中に設定し（s41)、送信元をＡＰにした図１０に示す経路維持バケットをブロードキャストし（s42)、経路維持返信バケットの受信待ちに入る（s43)。

【００４４】図９において、ノードＷＲ１は、経路維持バケットの受信待ちの状態にあり（s51)、所定時間内に特定ノードＡＰからの経路維持バケットを受信すると（s52)、経路維持バケットの発信元を確認する（s53)。そして、ノードＷＲ１の経路管理表の宛先ＡＰに対する隣接と経路維持バケットの発信元が一致する（ここではともにＡＰ）である場合には（s54)、発信元である特定ノードＡＰに対して経路維持返信バケットを送信する（s55)。経路維持返信バケットは、図１１に示すように、バケット種別、宛先、隣接、ホップ数、送信元、発信元から構成される。ここでは、バケット種別：経路維持返信、宛先：ＡＰ、隣接：ＡＰ、ホップ数：１、送信元：ＷＲ１、発信元：ＷＲ１に設定される。

【００４５】また、ノードＷＲ１は、発信元と自ノードに設定した経路維持バケットをブロードキャストする（s56)。この経路維持バケットは、バケット種別：経路維持、宛先：ブロードキャスト、隣接：ブロードキャスト、ホップ数：２、送信元：ＡＰ、発信元：ＷＲ１に設定される。

【００４６】この経路維持バケットを受信した他のノードも同様に処理し、それぞれ経路維持返信バケットを発信元に送信しながら経路維持バケットをブロードキャストする。ただし、ノードＷＲ３，ＷＲ６，ＷＲ７は、ノードＷＲ４からの経路維持バケットのホップ数が１であるので経路維持バケットをブロードキャストしない。経路維持返信バケットを受信した各ノードでは、経路管理表の宛先ＡＰに対する隣接のノード宛に順次経路維持返信バケットを転送し、最終的に特定ノードＡＰに到達する。

【００４７】図８において、特定ノードＡＰは、所定時間内に受信した経路維持返信バケットの送信元ＷＲ１を取り出し、経路管理表の宛先ＷＲ１に対応する各経路チェックを経路調査中からＯＫに変更する（s44,s45)。他の送信元からの経路維持返信バケットについても同様で

ある。特定ノードＡＰは、経路維持バケットをブロードキャスト後から所定時間経過すると、経路管理表の各経路チェックを調べ、経路調査中の宛先の経路に対しては経路の再構築を行う（s46)。

【００４８】（ＷＲ５とＷＲ７との間の障害発生時の処理：請求項５，１１）ＷＲ５とＷＲ７との間に障害が発生した場合には、ノードＷＲ１～ＷＲ６については経路維持返信バケットが特定ノードＡＰに返信されてくるので、特定ノードＡＰの経路管理表の各経路チェックはＯＫになっている。しかし、ノードＷＲ７からの経路維持返信バケットが特定ノードＡＰに到達しないので、対応する経路チェックは経路調査中のままである。したがって、特定ノードＡＰは、経路維持バケットをブロードキャスト後から所定時間経過すると、経路管理表の各経路チェックを調べ、経路調査中の宛先ＷＲ７の経路に対しては経路の再構築を行う。

【００４９】＜ＷＲ主導の実施形態：請求項３，４，６，９，１０，１２＞図１２は、ＷＲ主導の場合のノードＷＲ１～ＷＲ７の経路管理表を示す。なお、無線ネットワークの構成および特定ノードＡＰの経路管理表は、図１に示すものと同じである。

【００５０】ノードＷＲ１～ＷＲ７の経路管理表は、「宛先」、「隣接」、「ホップ数」の他に「経路チェック」の欄が設けられる。「経路チェック」は、経路維持返信バケットの受信確認によって、各ノードが所定時間内に経路維持バケットを受信したか否かを表すものである。

【００５１】（ＷＲ主導の第１の制御シーケンス：請求項３，９）ＷＲ主導の第１の制御シーケンスを図１３を参照して説明する。図１３は、ノードＷＲ１～ＷＲ７における制御シーケンスを示す。ここでは、ノードＷＲ６の場合について説明するが、他のノードＷＲ３，ＷＲ７についても同様である。

【００５２】図１２，１３において、ノードＷＲ６は、所定時間経過しても特定ノードＡＰ宛ての経路維持バケットを受信しないので（s61)、特定ノードＡＰ宛ての経路維持バケットを生成し、経路管理表に基づいて隣接のノードＷＲ４宛てに送信する（s62)。この経路維持バケット、バケット種別：経路維持、宛先：ＡＰ、隣接：ＷＲ４、ホップ数：３、送信元：ＷＲ６、発信元：ＷＲ６に設定される。そして経路維持返信バケットの受信待ちに入る（s63)。

【００５３】ノードＷＲ４は、所定時間内にノードＷＲ６から特定ノードＡＰ宛ての経路維持バケットを受信すると（s61)、経路管理表から宛先ＡＰに対する隣接ノードを検索し、ここではノードＷＲ１宛てに経路維持バケットを転送する（s64)。この経路維持バケットは、バケット種別：経路維持、宛先：ＡＰ、隣接：ＷＲ１、ホップ数：２、送信元：ＷＲ６、発信元：ＷＲ４に設定が変更される。そして経路維持返信バケットの受信待ちに入る（s65)。

【００５４】ノードＷＲ１は、所定時間内にノードＷＲ４から特定ノードＡＰ宛ての経路維持バケットを受信すると、ノードＷＲ４と同様に処理して特定ノードＡＰに経路維持バケットを転送する。この経路維持バケットは、バケット種別：経路維持、宛先：ＡＰ、隣接：ＡＰ、ホップ数：１、送信元：ＷＲ６、発信元：ＷＲ１に設定が変更される。

【００５５】特定ノードＡＰは、ノードＷＲ１から経路維持バケットを受信すると、経路維持バケットから送信元ＷＲ６を取り出し、ノードＷＲ６を宛先として経路管理表から得た隣接のノードＷＲ１に経路維持返信バケットを送信する。この経路維持返信バケットは、バケット種別：経路維持返信、宛先：ＷＲ６、隣接：ＷＲ１、ホップ数：３、送信元：ＡＰ、発信元：ＡＰに設定される。

【００５６】ノードＷＲ１は、経路維持返信バケットの受信待ちに入っており（s65)、所定時間内に特定ノードＡＰからノードＷＲ６宛ての経路維持返信バケットを受信すると（s66)、特定ノードＡＰへの経路が正常であることを認識し、経路管理表の宛先ＡＰの経路チェックをＯＫとする。そして、ノードＷＲ１はノードＷＲ６を宛先として、経路管理表から得た隣接のノードＷＲ４に経路維持返信バケットを転送する（s67)。この経路維持返信バケットは、バケット種別：経路維持返信、宛先：ＷＲ６、隣接：ＷＲ４、ホップ数：２、送信元：ＡＰ、発信元：ＷＲ１に設定が変更される。

【００５７】ノードＷＲ４は、所定時間内にノードＷＲ１からノードＷＲ６宛ての経路維持返信バケットを受信すると、特定ノードＡＰへの経路が正常であることを認識し、経路管理表の宛先ＡＰ，ＷＲ１の経路チェックをＯＫとする。そして、ノードＷＲ１と同様に処理してノードＷＲ６に経路維持返信バケットを転送する。この経路維持返信バケットは、バケット種別：経路維持、宛先：ＷＲ６、隣接：ＷＲ６、ホップ数：１、送信元：ＡＰ、発信元：ＷＲ４に設定が変更される。

【００５８】ノードＷＲ６は、経路維持返信バケットの受信待ちに入っており（s63)、所定時間内にノードＷＲ４から経路維持返信バケットを受信すると（s68)、特定ノードＡＰへの経路が正常であることを認識し、経路管理表の宛先ＡＰ，ＷＲ４の経路チェックをＯＫとする。このとき、宛先が自ノードであるので、経路維持返信バケットの転送を行わずに処理を終了する。

【００５９】（ＷＲ２とＷＲ５との間の障害発生時の処理：請求項６，１２）図１２，１３において、ノードＷＲ５は、ノードＷＲ７から経路維持バケットを受信し、上述した手順に従ってノードＷＲ２に経路維持バケットを転送し、経路維持返信バケットの受信待ち状態に入る（s65)。ここで、所定時間経過してもノードＷＲ２から経路維持返信バケットが返信されず（s66)、後述する障

害通知バケットも受信せずに所定時間経過した場合（s69,s70)や、受信した障害通知バケットが特定ノードＡＰの方向（宛先がＡＰの隣接）から送信されたものであれば（s71)、障害通知バケットを１ホップ分ブロードキャストする（s72)。この障害通知バケットは、バケット種別：障害情報、宛先：ブロードキャスト、隣接：ブロードキャスト、ホップ数：１、送信元：ＷＲ５、発信元：ＷＲ５に設定される。そして、経路管理表の隣接がＷＲ２の経路の設定を削除する（s73)。

【００６０】ノードＷＲ７は、経路維持返信バケットではなく障害通知バケットを受信し、経路管理表の宛先ＡＰに対する隣接と障害通知バケットの発信元がともにＷＲ５で一致した場合（s75)や、両バケットを受信しないまま所定時間経過すると（s76)、障害通知バケットを１ホップ分ブロードキャストし（s72)、特定ノードＡＰへの経路の設定を削除する（s73)。この障害通知バケットは、バケット種別：障害情報、宛先：ブロードキャスト、隣接：ブロードキャスト、ホップ数：１、送信元：ＷＲ５、発信元：ＷＲ７に設定される。

【００６１】また、ノードＷＲ４は障害通知バケットを受信すると、経路管理表の宛先ＡＰに対する隣接がＷＲ１であり、障害通知バケットの発信元がＷＲ５で一致しないので、この障害通知バケットを無視する。

【００６２】以上により、ノードＷＲ５、ＷＲ７は、特定ノードＡＰに対する経路の再構築を行う（s74)が、その方法は上述の本発明による方法や従来のＡＯＤＶ等の経路構築方法を用いてもよい。

【００６３】（ＷＲ主導の第２の制御シーケンス：請求項４，１０）ＷＲ主導の第２の制御シーケンスを図１４を参照して説明する。図１４は、ノードＷＲ１～ＷＲ７における制御シーケンスを示す。ここでは、ノードＷＲ５の場合について説明するが、他のノードについても同様である。

【００６４】図１２，１４(1)において、ノードＷＲ５は、ある時刻になると経路管理表の経路チェックをすべて経路調査中にする（s81)。そして、経路維持バケットを生成して１ホップ分ブロードキャストする（s82)。この経路維持バケットは、バケット種別：経路維持、宛先：ブロードキャスト、隣接：ブロードキャスト、ホップ数：１、送信元：ＷＲ５、発信元：ＷＲ５に設定される。そして経路維持返信バケットの受信待ちに入る（s83)。

【００６５】図１４(2)において、ノードＷＲ２が経路維持バケットを受信すると（s91)、経路維持返信バケットを生成し、経路維持バケットを送信したノードＷＲ５宛てに送信する（s92)。この経路維持返信バケットは、バケット種別：経路維持返信、宛先：ＷＲ５、隣接：ＷＲ５、ホップ数：１、送信元：ＷＲ２、発信元：ＷＲ２に設定される。経路維持バケットを受信するノードＷＲ４，ＷＲ７も同様である。

【００６６】図１４(1)において、経路維持返信バケットの受信待ち中のノードＷＲ５が、所定時間内にノードＷＲ２，ＷＲ４，ＷＲ７からの経路維持返信バケットを受信すると（s84)、経路管理表の隣接ＷＲ２，ＷＲ４，ＷＲ７の経路チェックのＯＫに設定する（s85)。

【００６７】（ＷＲ２とＷＲ５との間の障害発生時の処理：請求項６，１２）図１２，図１４(1)において、ノードＷＲ５は、所定時間内にノードＷＲ２からの経路維持返信バケットが受信されず（s84)、ノードＷＲ２との間に障害が発生したことを経路管理表の経路チェックが経路調査中のままであることから認識すると、経路管理表の隣接がＷＲ２の経路を経路構築中に変更する（s86)。経路構築中の経路は特定ノードＡＰの方向であるので、障害通知バケットを１ホップ分ブロードキャストする（s87)。この障害通知バケットは、バケット種別：障害情報、宛先：ブロードキャスト、隣接：ブロードキャスト、ホップ数：１、送信元：ＷＲ５、発信元：ＷＲ５に設定される。これにより、ノードＷＲ５は、特定ノードＡＰに対する経路の再構築を行う（s88)が、その方法は上述の本発明による方法や従来のＡＯＤＶ等の経路構築方法を用いてもよい。

【００６８】図１４(3)において、ノードＷＲ７は、障害通知バケットを受信し（s93)、経路管理表の宛先ＡＰに対する隣接と障害通知バケットの発信元がともにＷＲ５で一致した場合に（s94)、経路管理表の隣接がＷＲ２の経路を経路構築中に変更し（s95)、障害通知バケットを１ホップ分ブロードキャストする（s96)。この障害通知バケットは、バケット種別：障害情報、宛先：ブロードキャスト、隣接：ブロードキャスト、ホップ数：１、送信元：ＷＲ５、発信元：ＷＲ７に設定される。これにより、ノードＷＲ７は、特定ノードＡＰに対する経路の再構築を行う（s97)が、その方法は上述の本発明による方法や従来のＡＯＤＶ等の経路構築方法を用いてもよい。

【００６９】また、ノードＷＲ４は障害通知バケットを受信すると、経路管理表の宛先ＡＰに対する隣接がＷＲ１であり、障害通知バケットの発信元がＷＲ５で一致しないので、この障害通知バケットを無視する。

【００７０】

【発明の効果】以上説明したように、本発明は、各無線ノードが特定の無線ノードに頻繁にアクセスし、他の無線ノード間のアクセスが少ない無線ネットワークにおいて、特定無線ノードが各無線ノードに対して、または各無線ノードが特定無線ノードに対してユニキャストで経路維持バケットを送信し、経路維持バケットを受信したノードが経路維持返信バケットをユニキャスト送信し、経路維持バケットの送信ノードが経路維持返信バケットの受信確認により、特定無線ノードと各無線ノードとの間の経路を維持することができる。したがって、特定の無線ノードとの経路維持に対しては、経路維持に伴う遅

延を小さくし、無駄な経路構築処理、経路維持のための処理、これらの処理に伴う無線帯域の無駄を省くことができる。

【図面の簡単な説明】

【図１】無線ネットワークの構成例を示す図。

【図２】ＡＰ主導の場合の特定ノードＡＰの経路管理表を示す図。

【図３】特定ノードＡＰにおける経路維持パケット送信時の制御シーケンスを示す図。

【図４】ノードＷＲ１～ＷＲ７における制御シーケンスを示す図。

【図５】特定ノードＡＰにおける経路維持返信パケット受信時の制御シーケンスを示す図。

【図６】経路維持パケットの構成例を示す図。

【図７】経路維持返信パケットの構成例を示す図。

＊【図８】特定ノードＡＰの制御シーケンスを示す図。

【図９】ノードＷＲ１～ＷＲ７における制御シーケンスを示す図。

【図１０】経路維持パケットの構成例を示す図。

【図１１】経路維持返信パケットの構成例を示す図。

【図１２】ＷＲ主導の場合のノードＷＲ１～ＷＲ７の経路管理表を示す図。

【図１３】ノードＷＲ１～ＷＲ７における制御シーケンスを示す図。

【図１４】ノードＷＲ１～ＷＲ７における制御シーケンスを示す図。

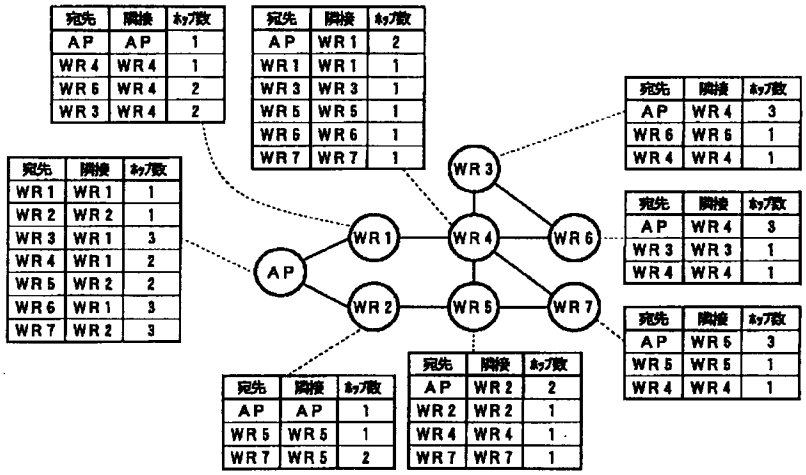
【符号の説明】

ＡＰ　特定無線ノード（特定ノード）

ＷＲ　無線ノード（ノード）

【図１】

無線ネットワークの構成例



宛先	隣接	ホップ数
AP	AP	1
WR4	WR4	1
WR5	WR4	2
WR3	WR4	2

宛先	隣接	ホップ数
AP	WR1	2
WR1	WR1	1
WR3	WR3	1
WR5	WR5	1
WR6	WR6	1
WR7	WR7	1

宛先	隣接	ホップ数
AP	WR4	3
WR6	WR6	1
WR4	WR4	1

宛先	隣接	ホップ数
WR1	WR1	1
WR2	WR2	1
WR3	WR1	3
WR4	WR1	2
WR5	WR2	2
WR6	WR1	3
WR7	WR2	3

宛先	隣接	ホップ数
AP	WR4	3
WR3	WR3	1
WR4	WR4	1

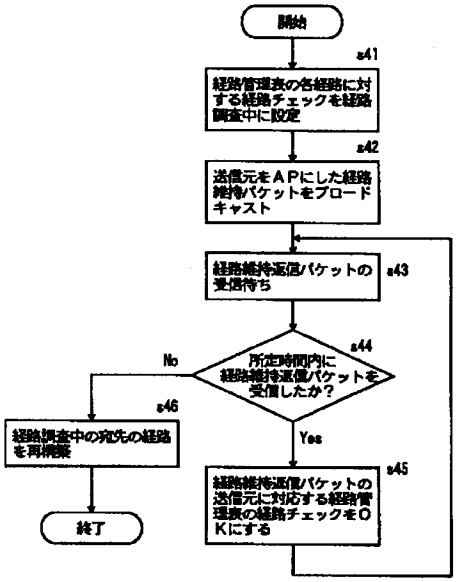
宛先	隣接	ホップ数
AP	WR5	3
WR5	WR5	1
WR4	WR4	1

宛先	隣接	ホップ数
AP	AP	1
WR5	WR5	1
WR7	WR5	2

宛先	隣接	ホップ数
AP	WR2	2
WR2	WR2	1
WR4	WR4	1
WR7	WR7	1

【図８】

特定ノードＡＰの制御シーケンス



【図７】

経路維持返信パケットの構成例

(1)　WR３

パケット種別：経路維持返信
宛先：ＡＰ
隣接：ＷＲ４
ホップ数：３
送信元：ＷＲ３
発信元：ＷＲ３
正常経路：ＷＲ３

(2)　WR４

パケット種別：経路維持返信
宛先：ＡＰ
隣接：ＷＲ１
ホップ数：２
送信元：ＷＲ４
発信元：ＷＲ４
正常経路：ＷＲ３
正常経路：ＷＲ４
正常経路：ＷＲ６

(3)　WR１

パケット種別：経路維持返信
宛先：ＡＰ
隣接：ＡＰ
ホップ数：１
送信元：ＷＲ１
発信元：ＷＲ１
正常経路：ＷＲ１
正常経路：ＷＲ３
正常経路：ＷＲ４
正常経路：ＷＲ６

【図１０】

経路維持パケットの構成例

パケット種別：経路維持
宛先：ブロードキャスト
隣接：ブロードキャスト
ホップ数：３
送信元：ＡＰ
発信元：ＡＰ

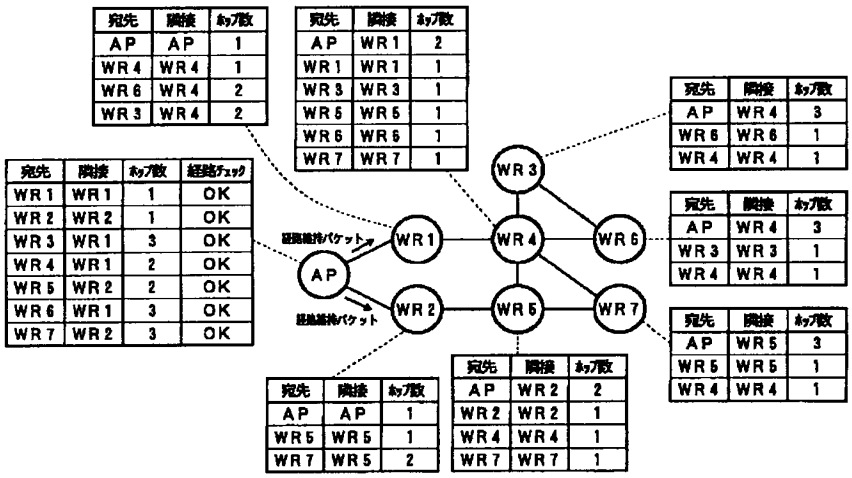
【図１１】

経路維持返信パケットの構成例

パケット種別：経路維持返信
宛先：ＡＰ
隣接：ＡＰ
ホップ数：１
送信元：ＷＲ１
発信元：ＷＲ１

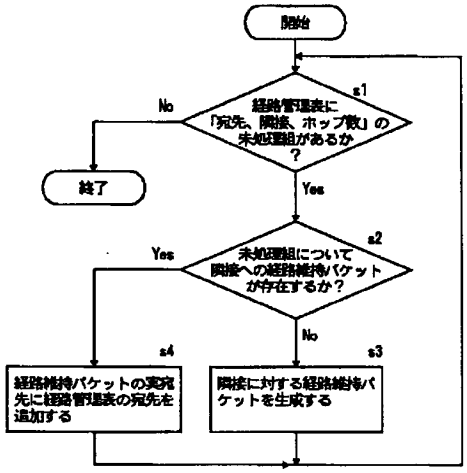
【図２】

ＡＰ主導の場合の特定ノードＡＰの経路管理表



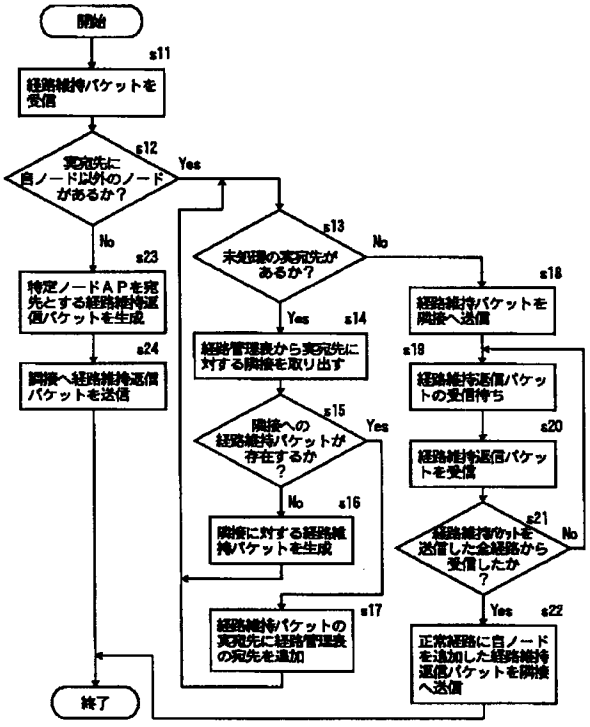
【図３】

特定ノードＡＰにおける経路維持パケット送信時の制御シーケンス



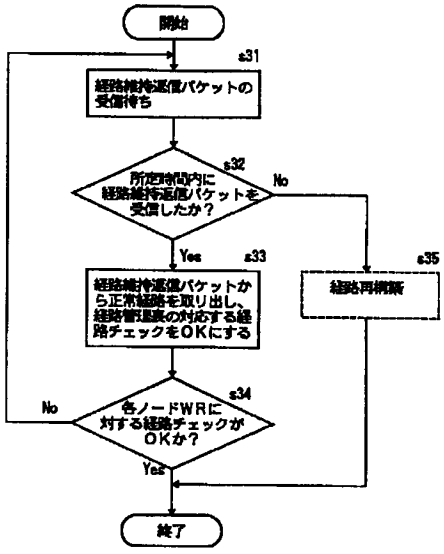
【図４】

ノードＷＲ１～ＷＲ７における制御シーケンス



【図５】

特定ノードＡＰにおける経路維持返信パケット受信時の制御シーケンス



【図６】

経路維持パケットの構成例

(1) [WR1, WR1, 1]

パケット種別：経路維持
宛先：WR1
隣接：WR1
ホップ数：1
送信元：AP
発信元：AP
実宛先：WR1

(2) [WR3, WR1, 3]

パケット種別：経路維持
宛先：WR1
隣接：WR1
ホップ数：1
送信元：AP
発信元：AP
実宛先：WR1
実宛先：WR3

(3) [WR4, WR1, 2]

パケット種別：経路維持
宛先：WR1
隣接：WR1
ホップ数：1
送信元：AP
発信元：AP
実宛先：WR1
実宛先：WR3
実宛先：WR4

(4) WR1方向

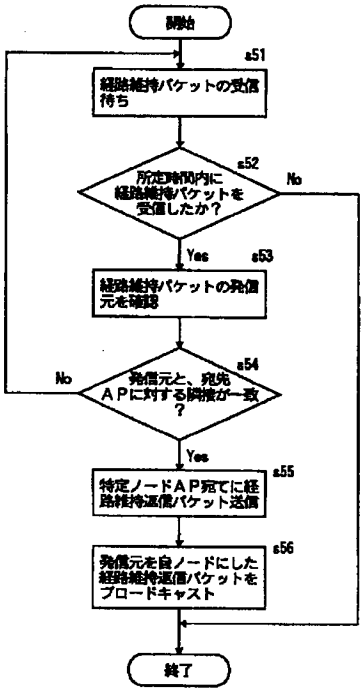
パケット種別：経路維持
宛先：WR1
隣接：WR1
ホップ数：1
送信元：AP
発信元：AP
実宛先：WR1
実宛先：WR3
実宛先：WR4
実宛先：WR6

(3) WR2方向

パケット種別：経路維持
宛先：WR2
隣接：WR2
ホップ数：1
送信元：AP
発信元：AP
実宛先：WR2
実宛先：WR5
実宛先：WR7

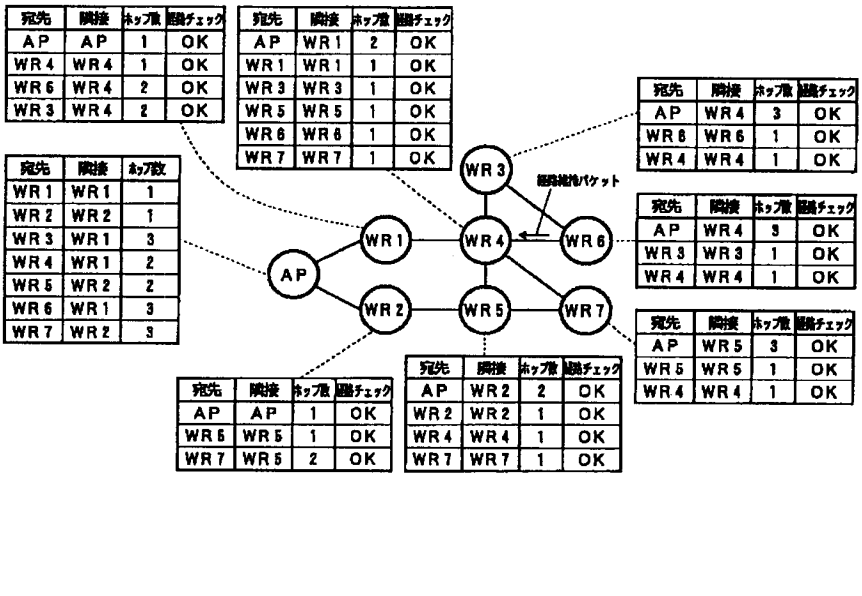
【図９】

ノードＷＲ１～ＷＲ７における制御シーケンス

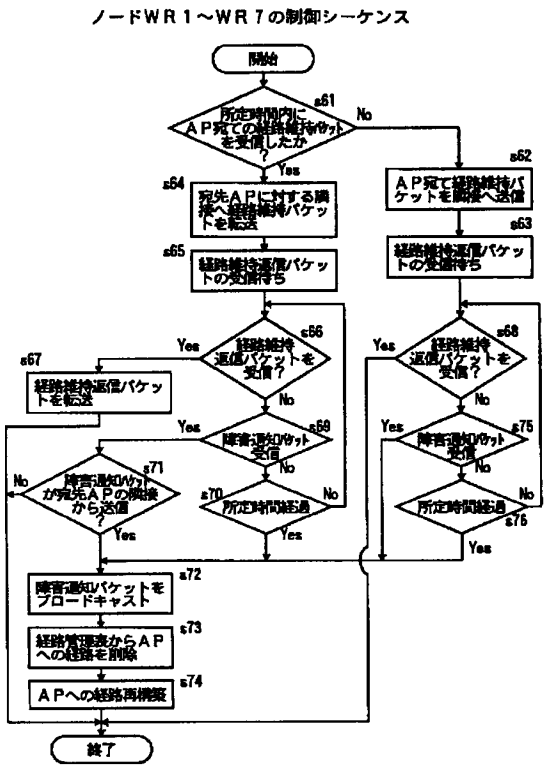


【図１２】

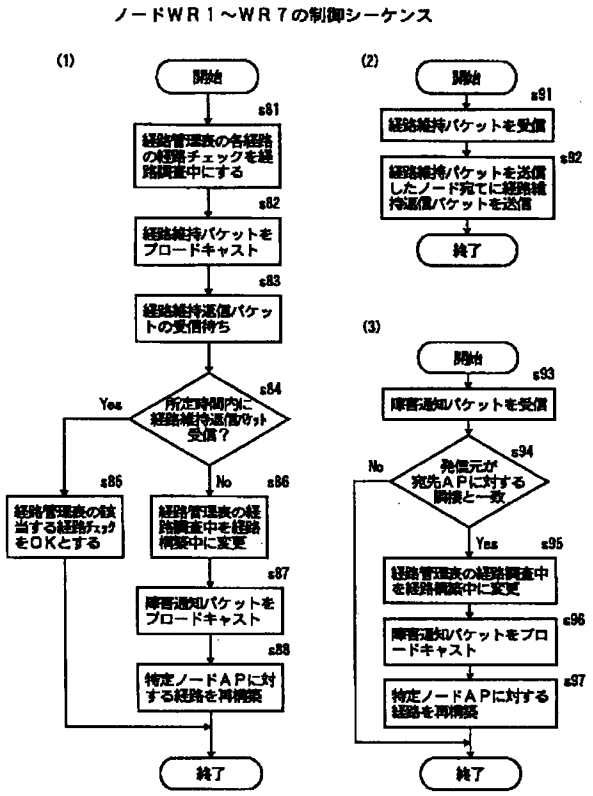
ＷＲ主導の場合のノードＷＲ１～ＷＲ７の経路管理表



【図１３】



【図１４】



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